ARCHIVES OF

Physical Medicine and Rehabilitation

MARCH 1961
Volume 42, No. 3

Archives of Physical Medicine and Rehabilitation

Code of Advertising

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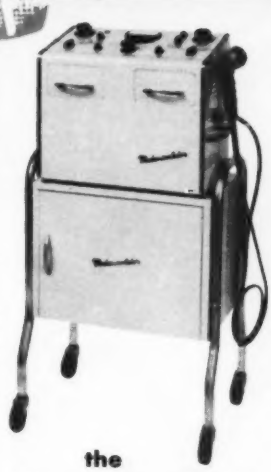

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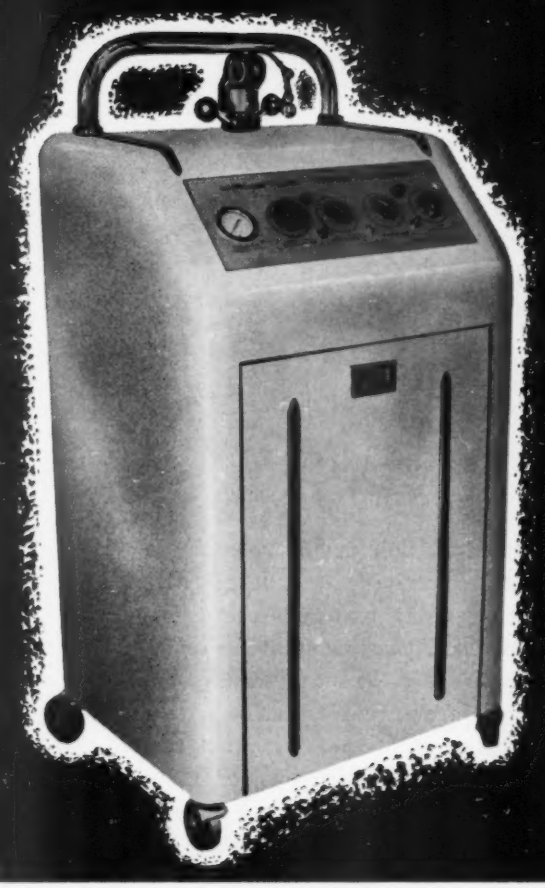

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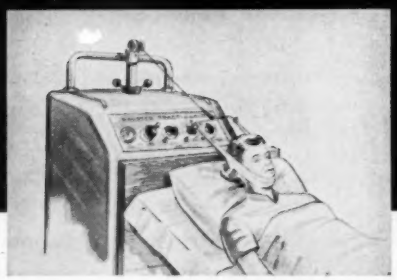

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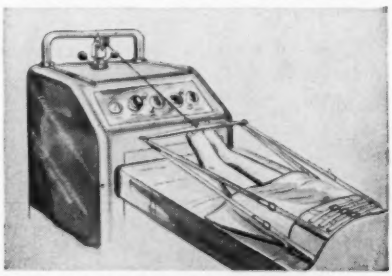

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It is becoming more and more obvious that the folks who pooh-pooh Physical Medicine are missing the boat. Diathermy, ultrasonics, muscle stimulation and hydro-therapy are being endorsed by many of the same hospitals that a few years ago described the field as "no value." (In fact, we received a very large order the other day from an eastern hospital who 7 years ago told our representative that he was "wasting his time" in even calling on them!) I only hope that the Physiatrist and Physical Therapist continue to climb, money-wise, so that the reward is a little more tangible and a little less abstract!

In line with the above, there is an even brighter prospect in sight. I was reading an article this morning telling how the "experts" have evaluated the growth of many new aspects of U. S. culture over the past decade. One of their examples was the trampoline industry, which has grown over 600% since 1957. I can't help but feel that more trampolines mean more waiting lines in every Physiatrist's office. Personally, I'm all for it . . . unless, of course, *I'm* at the end of the line!

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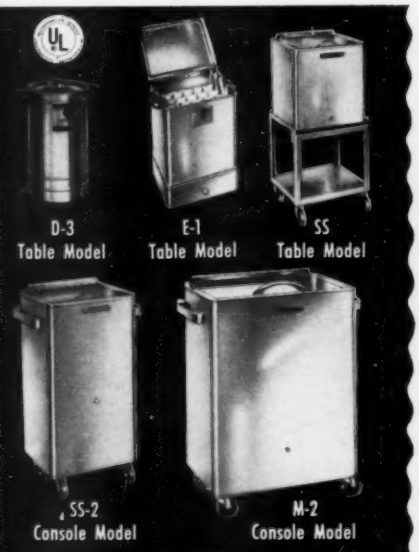

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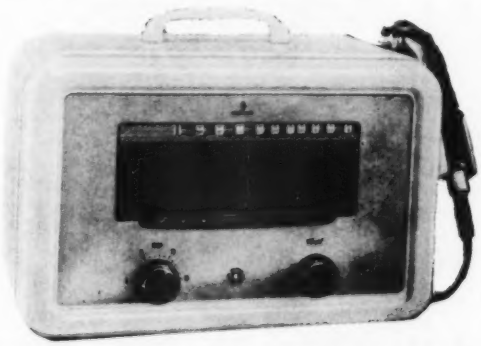

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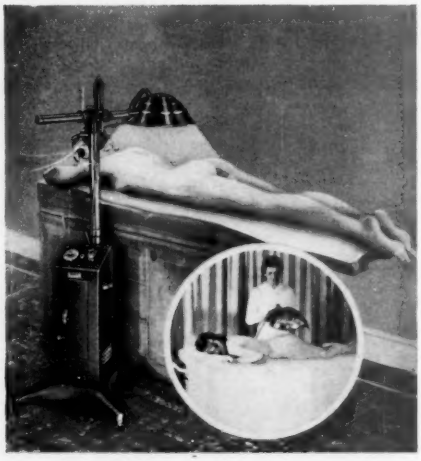

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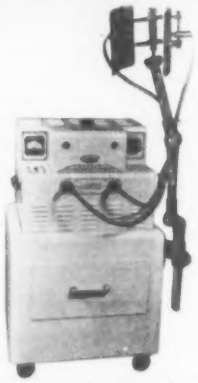

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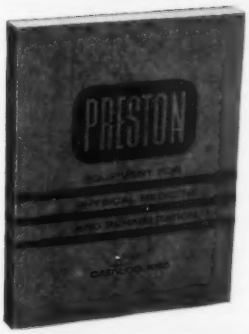

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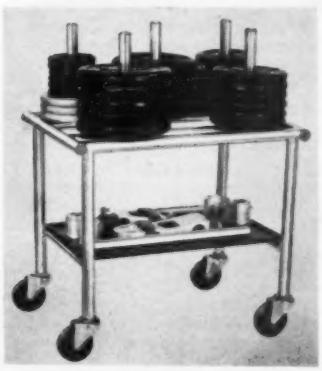

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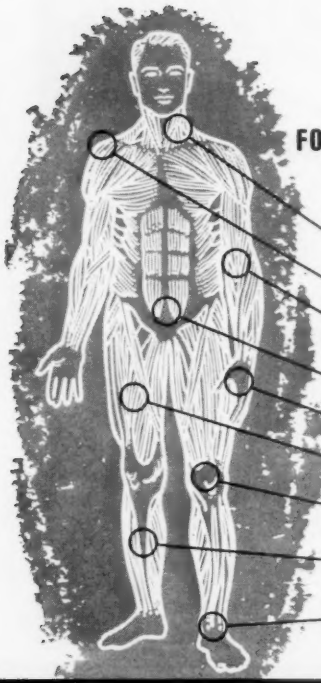

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Influence of Weight-Bearing and Muscle Contraction On Disuse Osteoporosis

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and
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New York City

● Osteoporosis occurs where there is loss of function of sufficient degree. Standing and ambulation are among the most commonly used therapeutic measures to prevent or reverse such osteoporosis. No acceptable evidence exists that this form of osteoporosis is reversible. Recent metabolic studies also cast grave doubt upon the conception that weight-bearing can prevent it. A critical review of the literature suggests that despite weight-bearing, metabolic losses from bone will continue unless muscle contraction of sufficient degree is available to prevent them. It is pointed out that without any form of treatment, metabolic losses are self-limited.

Disuse osteoporosis results from the reduction of stress upon and strain within bone.[1] The size, shape and internal architecture have been attributed to the forces acting upon the skeleton.[2, 3] Normal structure is the result of forces produced by normal function, whereas deviations in structure have been related to changes in these forces.[4, 5] Although their nature and mode of action are not clearly understood, they have been attributed to pressure, tension or muscle action or to various combinations of these acting upon bone.[6, 7]

Disuse osteoporosis is a frequent concomitant of those disabling conditions in which motor function becomes limited. It presents a clinical problem because of its relationship to lagging growth, urinary calculi, soft tissue ossification and susceptibility to fracture.[4, 8] Therapeutic efforts directed towards prevention of osteoporosis are assumed to be effective in preventing these complications. Therapeutic methods which attempt to simulate normal "stress and strain" require critical re-evaluation in light of newer knowledge.

Causes of Osteoporosis

The outstanding characteristic of osteoporosis is that the ratio of protein bony matrix to calcium content remains the same no matter how dense or atrophic the bone may be. This is explained by the fact that bone protein undergoes constant building up and breaking down and that this protein binds calcium in a fixed proportion. If protein is not built up at a normal rate or is broken down at faster than a normal rate, calcium content of bone is that much less and the excess calcium is excreted. These conditions are true when there is protein deprivation, as occurs in starvation, and when there are direct effects on protein by hormone and vitamin excess or deficiency. Thus all the following may cause osteoporosis; the excessive pituitary or adrenal cortical hormone secretion of Cushing's Syndrome; the steroid treatment of arthritis; gonadal hormone deficiency as occurs following menopause or in aging; insulin deficiency as in diabetes or thyroid hormone excess as occurs in Graves' Disease. Vitamin C deficiency as in scurvy also leads to this form of bone atrophy through the loss of its effect on maturing the osteoid.[9] Thus there are many causes of osteoporosis besides the loss of "stress and strain." Of course, multiple causes of osteoporosis are frequently operative. Gitman, et al, showed that 72 per cent of their aged patients who showed osteoporosis were ambulatory.[10] In their bedridden group however, there was a fourfold greater incidence of radiologically severe osteoporosis. There also are many methods of treatment depending upon cause. Sometimes these methods cross over as in the attempts to treat bone loss by sex hormone when the cause is most likely that of disuse. That this method is only partially effective may be due to difference in causation. The present concern is with that form of osteoporosis resulting from inactivity and immobilization, often a common denominator in many pathologic states.

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Read at the 3rd International Congress of Physical Medicine, Session on Neuromuscular Diseases, Washington, D. C., August 24, 1960.

Metabolic Studies in Disuse Osteoporosis

Metabolic studies have confirmed the relationship of bone rarefaction and formation to the forces applied to it.[11, 12] The negative nitrogen balance which is a characteristic finding in disuse is said to reflect continuing protein catabolism in the presence of reduced protein anabolism. Since protein occurs in almost all tissues, a study of nitrogen balance is a study of total body protein change. The total body calcium lies largely within bone and is thoroughly dependent upon and reflects the amount of protein bony matrix (osteoid). Because of this a study of the relationship between calcium intake and output clearly reflects change within the skeleton. Thus the process of bone atrophy will increase calcium excretion in the presence of relatively constant daily calcium intake. There is increased calcium output from normal immobilized young men, from individuals immobilized for fracture and from patients with extensive flaccid paralysis.[11-13] The degree of immobilization appears to be greater in each succeeding case. One study emphasizes the average daily calcium excretion in pointing out that it is greater with greater degrees of immobilization.[14] The number of patients in this study was too small and the variations too great to make averages meaningful. On the other hand, another study relates longer duration of abnormal calcium loss to greater degrees of immobilization.[12] With any degree of immobilization, bone tends to reach a new metabolic balance with the passage of time. The ultimate degree of osteoporosis obviously reflects total calcium loss. This is dependent upon average daily loss and duration. This may be the common denominator in both studies. The reason for the new metabolic balance may be that during depletion a point is reached where the reduced level of activity is sufficient to prevent further loss of density of bone.

Therapeutic Methods

It has been stated that ambulation may prevent osteoporosis in the paraplegic.[8] Freeman reported that ambulation and even standing reduced calcium loss.[15] However, he did not measure calcium intake and output was measured by a questionable method. Nevertheless, at this period the therapeutic use of weight-bearing became popular.

Whedon and Shorr found that calcium output was reduced by use of the rocking bed in immobilized normal young men but not in patients with extensive paralysis due to poliomyelitis.[16, 17]

Wyse and Pattee stated that they could not demonstrate significant favorable effects by rocking or standing paraplegics.[18] They concluded that "stress and strain" results primarily from muscle contraction. However, on careful analysis of their data, a favorable effect did occur in one patient with a sixth-seventh dorsal vertebrae cord lesion. These results were discounted since they were inexplicable. This patient was reported as flaccid upon admission to the hospital two months before the study began. It is conceivable that he was passing from the state of spinal shock to that of spasticity. His neurologic status at the time of the study was not reported. If it were true that this patient became spastic it would tend to support their conclusion. The other patients in the study had lesions of the 11th-12th dorsal vertebrae cord and were obviously flaccid paraplegics.

Plum and Dunning found no fall in calcium output in poliomyelitis patients who were rocked in bed, exercised under water, mobilized in a wheelchair and ambulated with crutches and braces.[19] One patient who could ambulate with canes did show a fall in calcium output. Considerably more functioning muscle is required to do this as compared to crutch and brace ambulation. These findings suggest that the force applied to bone by contracting muscle is the most effective means of preventing osteoporosis due to disuse.

Calcium losses sometimes can be reduced by heavy resistance exercise in cases of bone atrophy occurring with rheumatoid arthritis.[20] Geiser and Trueta demonstrated that electrically stimulated muscle contraction reduced the rarefaction of bone resulting from immobilization in the rabbit.[21]

Another unknown factor besides disuse has been postulated in the production of osteoporosis in poliomyelitis. Dunning and Plum showed slightly increased calcium output of very short duration in patients with seemingly normal function except for mild bulbar involvement.[12] Bodian stated that the clinically evident paralysis often is a poor index of the amount of neuronal damage.[22] Moskowitz and Kaplan studied 75 cases of so-called non-paralytic poliomyelitis.[23] Twenty-nine of these patients showed muscular weakness on followup, one and one-half to six years after onset. They explained this by the fact that at the time of discharge these patients were only on ward activity level. The limited endurance and fatigability of the involved muscles became apparent in the performance of more stressful normal daily avocational and vocational activities. Patients of this type even while hospitalized may demonstrate widespread minor weaknesses on careful manual muscle testing and diffusely scattered fibrillations in electromyographic examination.

Reversibility of Osteoporosis

Discussion to this point has dealt with the prevention of osteoporosis rather than its reversal. Albright contended that although osteoporosis could be arrested, it was not reversible. Moldawer, who quoted the foregoing, stated that there was no convincing radiographic evidence of the reversibility of osteoporosis in the adult.[24] Iannacconne and his co-workers found that once osteoporosis of vertebrae occurred in Cushing's Syndrome, the affected bone remained so indefinitely following cure of the disease. In growing children, bone of normal density would grow around the osteoporotic area.[25] Howard stated that the same was true of the osteoporosis of scurvy.[26] There is apparently no evidence in the literature that disuse osteoporosis behaves in any different fashion.

Comment

There seems to be a proportional relationship between reduction of muscle contraction and calcium loss and between functional level and bone density.

Cuthbertson's study done in 1929 was the first attempt to relate reduced activity in the human with metabolic losses. His control period was too short, the immobilization done with sand bags was slight and inconstant and it was of too short duration. He found that calcium losses tended to be slight but seemed to show a trend towards an increase.[27] In Johnston's study, tuberculous adolescents at bed-rest unrestrained by plaster, paralysis or musculoskeletal disability showed little or no loss during the first four months. Metabolic losses which began to occur after this initial period, possibly because greater adaptation to bed-rest leads to reduced activity, were prevented by short periods of bicycle exercise done in bed.[28] Young men without disruption of nerve-muscle-bone continuity but restrained during bed-rest by plaster spica fixation, showed a significantly greater excretion of calcium.[11] Individuals immobilized for fracture or osteotomy showed still larger losses.[13] In the latter case, the immobilization would seem to be less since there was single spica fixation rather than the double spica used in normal young men. Movement in plaster is possible unless there is inhibition of muscle contraction because of fear of pain.[29] This is more likely to occur in case of fracture. Larger losses of calcium occurred in patients with flaccid paralysis of multiple muscle groups. The greatest of all were found in the tetraplegic paralytic.[12] It is interesting to note that in none of these clinical and experimental conditions was there any weight-bearing and yet calcium losses differed.

It would seem that the evidence is in favor of muscle contraction and against weight-bearing in terms of their ability to prevent osteoporosis. The forces produced by either are considerably different from the other in order of magnitude. A standing 150 pound individual will produce about 65 pounds of compression on one femur. Muscles acting upon this bone can produce forces many times greater. Besides, muscle action creates torsion, shearing and bending as well as compressive forces, all of which may be important in bone retention.

Small as the stress of weight-bearing

may be, metabolic studies have not necessarily proved its complete insignificance. Bone retention can be demonstrated along a narrowed column of weight-bearing in a limb bone, when the rest of that bone, being non weight-bearing, will show marked osteoporosis[8] (fig. 1). No study has thus far been long enough to establish whether weight-bearing does or does not shorten the duration or reduce total loss of calcium. Plum and Dunning studied tetraplegic polios for only 27 weeks under conditions of therapeutic mobilization even though

Fig. 1 — A case of flaccid paraplegia with soft-tissue ossification bridging the posterior aspect of the knee joint. This limb is weight-bearing when the patient moves from bed to chair and from chair to automobile. Despite the intense osteoporosis elsewhere, the fusion has created a narrowed weight-bearing column along the posterior cortices of the tibia and femur. As a result, these cortices are dense.

they had already established that metabolic losses could last as long as 52 or more weeks.[19] Most investigators emphasized immediate reduction in rate of calcium loss rather than a reduction of total calcium loss.

Therapeutically, this becomes important in the patient with flaccid paralysis since forces of muscle contraction are not available. In spasticity, there is a small amount of evidence that the involuntary muscle contraction may hold on to bone.[18] Ambulation in the spastic may stimulate even greater muscle action. In flaccid paralysis, anabolic agents partially prevent calcium loss.[30] The effectiveness of electrical stimulation of innervated muscle in the rabbit has been established but its effectiveness in stimulating denervated muscle in the human has not. Anabolic agents and ambulation, even if not completely adequate, seem to be the only available therapeutic tools in limiting osteoporosis in cases of flaccid paralysis. Because it is not known whether osteoporosis is reversible, treatment must be instituted as early as possible.

Summary and Conclusions

1. Osteoporosis has been defined and has been found to have many causes.

2. Disuse is only one cause by reason of the reduction of "stress and strain" upon bone.

3. Frequently, there are multiple causes of osteoporosis in the same individual.

4. There is no unequivocal evidence that osteoporosis is reversible. Therefore, the therapeutic effort should be directed towards prevention.

5. Disuse osteoporosis and its resultant metabolic losses are self-limited. Losses are greater with greater immobilization.

6. Therapy based on other than primary cause can be expected to have only limited effectiveness.

7. Muscle action is the most effective stress upon bone preventing disuse osteoporosis.

8. Weight-bearing is much less effective than muscle action but it is probably not entirely ineffective in limiting osteoporosis.

9. The muscle action of spasticity is useful in that it probably preserves bone.

10. Anabolic agents can partially limit disuse osteoporosis.

11. Therapy should be applied early.

12. Disuse osteoporosis should be a rewarding field of investigation.

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Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.

Postoperative Care in Lumbar Disc Syndrome

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● A review of the literature on results of surgery for lumbar disc syndrome reveals little information on postoperative care of the back. The purpose of this study is to assess the results of 179 such cases in which a careful evaluation of the mechanical aspects of the back, during the early postoperative period, was made. Therapeutic measures are individually prescribed. These include exercises for strengthening weak muscles of trunk and lower extremities; posture correction including protection of back while bending or lifting; correction of gait with cane(s), crutch(es) or brace; and other adjuncts such as heel lift and weight reduction. Results were evaluated by recheck visits one and two months after surgery in most cases and a questionnaire. Results were classified as excellent, 42 per cent; improved, 52 per cent; and unimproved or worse, six per cent. Only six cases (three per cent) required spinal fusion later. The low incidence of poor results and low incidence of fusion after disc surgery, both of which are better than most series reported in the literature, are attributed to (1) careful preoperative evaluation of all aspects of the back as well as the disc problem; (2) close cooperation during the early postoperative period between neurosurgeon and physiatrist, and (3) individually prescribed measures for total rehabilitation of the back.

In the extensive literature on lumbar disc surgery much attention is given to the many and various changes of a mechanical nature in the back and lower extremities which are associated with disc syndrome. It would logically follow that in the discussions of treatment and postoperative care of such cases an equal consideration would be given to the correction of these mechanical factors. However, it has been found there is a distinct paucity of information not only on correction of these associated mechanical factors but also on the entire aspect of postoperative care following disc surgery.

Of the many reports[1-14] we have reviewed, Munro[1] gives the most consideration to postoperative care. He points out that paraspinal muscles are shortened, weakened, and atrophied as a result of spasm. He recommends stretching and strengthening of these shortened muscles by active (not passive) exercises and rebuilding the body generally. What these stretching and strengthening exercises are and how they are performed are not mentioned. Caldwell and Sheppard,[2] in a paper the conclusion of which is stated in the simple sentence "there are *no* criteria for spinal fusion following disc surgery," recommend stricter supervision of convalescence by (1) weight control, (2) regulated increase in activity, (3) special exercises to strengthen and increase suppleness of involved muscles, (4) an explanation to the patient of the cause of residual pain and (5) reassurance. The special exercises are not described. Spurling and Grantham[3] agree that convalescence should be strictly supervised, recommending recumbency for the first ten days, ambulation on the 13th day, dismissal on the 14th day, and return to sedentary work in four weeks. Woolsey and Tsang,[4] on the other hand, recommend getting postoperative patients up as early as possible, the second or third postoperative day, and dismissal on the seventh postoperative day. Poppen[5] just recommends that the patient should be allowed to set his own postoperative course.

O'Connell[6] advises allowing the patient to move freely in bed, getting up on the eighth postoperative day, and beginning spinal exercises on the 10th postoperative day. These exercises are not described except for the remark that they should be continued so that by the end of three weeks the patient should be able to touch finger to toes, implying these involve flexion of the trunk.

None of these reports give details of postoperative evaluation and an individ-

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Read at the 3rd International Congress of Physical Medicine, Session on Physiatric Care Following Trauma, Washington, D. C., August 25, 1960.

ually planned program of postoperative treatment and care such as that evolved by the authors through close cooperation made possible by group practice in a clinic. It therefore seemed worthwhile to review our own cases to see how the results of this postoperative program compared with other reports. Of the 312 cases in which protruded or ruptured lumbar intervertebral disc was removed surgically by laminotomy during the four and one-half year period between June, 1951, and Dec. 31, 1955, at the Hitchcock Hospital, the majority were seen in consultation by the physiatrist. Questionnaires regarding results of the surgery were sent to all 312 patients. Of the 215 returning satisfactorily completed questionnaires, 179 had been seen by a consultant in physical medicine and rehabilitation, the back evaluated from a mechanical standpoint, and appropriate measures prescribed. These 179 cases were selected for review in this study. All cases had fulfilled in the preoperative evaluation at least two of our three criteria for surgical correction of lumbar disc: (1) typical history, (2) positive neurologic changes, and (3) positive myelogram.

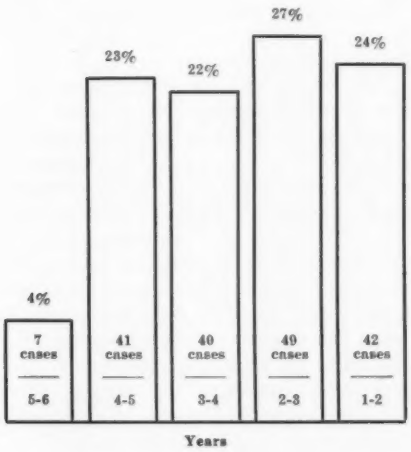

Fig. 1 — Time interval since operation.

All these disc operations were performed by two of us who are neurosurgeons (Drs. Sachs and Fisher). Spinal fusions were done by orthopedic surgeons. Generally most of these patients returned for recheck by the neurosurgeon at least twice, one month and two months after dismissal. They were followed until maximum benefit was obtained which varied from two to 12 months. The length of followup was no shorter than one year (24 per cent between one and two years) and no longer than five to six years (four per cent) (fig. 1). The questionnaire was worded as follows:

1. PLEASE PUT AN "X" IN FRONT OF ONE OF THESE STATEMENTS:

I think the operation cured me.

I think the operation helped, but did not cure me.

I think I am about the same as before the operation.

I think I am worse than I was before the operation.

2. Did you feel relieved of pain before you left the hospital?_____.

3. When did you begin feeling better?_____.

4. Do you still have pain?_____If so, describe what it is like_____.

5. Are you working?_____When did you return to work?_____.

a) What kind of work are you doing?_____.

b) What kind of work did you do before the operation?_____.

c) What kind of work did you do before your trouble started?_____.

d) Are you getting compensation now?_____.

e) Does working bother your back?_____Your legs?_____.

6. Are you worse in any way than before the operation?_____If so, please tell how_____.

7. If you are not well, are you in any way better than you were before the operation?_____Please tell how_____.

8. In general, are you glad or sorry you had the operation?_____.

Postoperative Program

The patients in this series were referred to the department of physical medicine and rehabilitation on the fifth to 10th postoperative day, usually on the day it became possible to be up ambulating without pain. The consultant in physical medicine and rehabilitation examined

each patient and reviewed his record for possible mechanical disorders of the trunk or lower extremities which might have some effect on the back. Of considerable help in this was the preoperative evaluation, which often included orthopedic consultation and roentgenograms with oblique views of the lumbar vertebrae. Treatment was planned on an individual basis and included several or sometimes many of the following:

I. Exercises
II. Posture correction
III. Carefully controlled limitation of activities
IV. Treatment of associated disorders
V. Gait corrections
VI. Correction of occupational strains

I. *Exercises.* These were prescribed for three general purposes (table 1): (1) strengthening weak muscles, (2) stretching out contractures, and (3) improving posture. Most often one thinks of strengthening only back extensors following lumbar disc surgery but careful examination also often reveals weaknesses of abdominal and quadratus lumborum muscles. Weakness of foot and ankle groups often went unrecognized at first even when these weaknesses made balancing on that foot difficult. This difficulty was incorrectly attributed to general postoperative unsteadiness. It was surprising occasionally to find weakness in the hip abductors or quadriceps even in cases where the nerve root involved was the first sacral. This weakness was apparently on the basis of disuse. Strengthening of back extensors and abdominals were prescribed in a progressive plan so that as strength was gained the exercises were made more difficult. No flexion of the trunk, such as sit-ups, was started for abdominal strengthening exercises until the patient had returned one month after dismissal from the hospital and a check by the examiner insured that residual sciatic irritation of the back would not be aggravated by this type of exercise. Strengthening of back extensors by extending the back while prone was made more comfortable and easier to perform by using one to three pillows under the pelvis and abdomen, depending on the amount of lumbar lordosis.

Table 1: Exercises in Postoperative Care of Lumbar Disc

1. **Strengthening**
a. trunk muscles
abdominals
back extensors
quadratus lumborum
b. lower extremities
quadriceps
foot and ankle muscles
hip abductors
2. **Stretching of Contractures**
a. lumbar back extensors
b. hip flexors
c. knee flexors
3. **Posture Improvement**
a. pelvic roll
b. proper lifting and bending

Stretching of tight, contracted back extensors was necessary in almost all cases. This was done only by performance of active pelvic roll to flatten lumbar lordosis while supine. Combined flexion of knees, hips, and pelvis is a more effective manner for performance of this exercise but was avoided until later in the convalescence because of the possibility of its stretching nerve roots. The stretching out of slight (and therefore subtle) flexion contractures of a knee and one or both hips helped in several cases by correcting a pelvic tilt or functional scoliosis which may have kept the back under a chronic strain for a long period prior to surgery.

The maintenance of good posture was considered important for all cases for two reasons. First, a mildly increased lumbar lordosis may be one of several factors in the etiology of disc rupture and its persistence may cause continued back pain. Secondly, since weakness of back extensors is such a common finding in postoperative disc cases, particularly locally where they have been stretched by retraction during surgery (sometimes to the point of partial denervation[15]), it was most important to protect this weakness by proper give and take between these muscles and the abdominals. This balance between these two opposing groups of muscles occurs only when posture is quite good.[16]

Posture exercise was taught first as pelvic roll supine and, when this could be performed well, the patient learned to perform it standing, flattening the lumbar

area to the wall. The patient was taught to pull the abdomen up and in so as to pull the pelvis up in front and to contract gluteal muscles so as to pull pelvis down in back. Coordinated with this movement of pelvis the chest was held high and chin retracted to minimize cervical lordosis. When these maneuvers could be well executed by the patient he was then taught how to bend and lift not only by flexing the knees but also by using the abdominal and gluteal muscles to help support the back.

II. *Posture Correction.* The foregoing exercises were probably the most important measures in posture correction but also included were weight reduction, temporary use of back brace or corset, and correction of pelvic tilt. An obese, protruberant abdomen probably was one of the most common causes of increased lumbar lordosis. With weight loss to reduce the size of the abdomen, the forward displacement of the center of gravity was retracted so that the abdominal muscles again could resume performing their share of supporting the trunk anterior to the center of gravity balancing the action of the back extensors posterior to it. Supports, corsets, and braces were used rarely and even then only temporarily to help hold the abdomen up and in to reduce lumbar lordosis until sufficient strength had been gained in the abdominal muscles to perform this without external support. A functional scoliosis or tilt of the pelvis was always studied carefully to try to find any factors contributing to it which might be correctible such as a lift for shortening of a lower extremity. The chronic strain on the back from a scoliosis or pelvic tilt usually played an important role in the etiology of disc protrusion and if allowed to persist could be the cause of continued back pain even though the associated radiculitis might have been relieved by surgery.

III. *Limitation of Activities.* A characteristic postoperative condition that was present in every one of these cases to a greater or lesser degree was easy fatigue of the back. There seemed to be a direct relationship between weakness and easy fatigue of the back; the weaker the back extensors the more rapidly and easily the back became fatigued. Walking was not required to produce this fatigue. It was brought on by just being upright, whether sitting, standing, or walking. Long discussions were carried on with each patient until it appeared he understood two general principles: (1) exercises cannot strengthen muscles which are already overtired from being up too much; (2) it is preferable to be up many times for short periods than to stay up a long period only a few times a day. For example, the patient was initially allowed to be up three to five minutes three times a day. If this was well tolerated it was increased to six times a day. In turn if this was well tolerated these short periods up were increased to once an hour while awake. Only after this was well tolerated was the duration of time up increased. If stiffness of the back in early mornings was experienced it was attributed to over-fatigue of muscles the previous day and so the number of times being up was decreased. It was difficult to convince some patients, except by trial and error, that strengthening of the back and increasing its tolerance for activity could not be accelerated by his forcing himself to stay up long periods past the point of fatigue of the weak back muscles.

IV. *Treatment of Associated Disorders.* Some disorders which are associated with chronic back strain also can be associated with disc protrusion requiring surgical correction. For this reason each case was carefully reviewed for the presence of such disorders as chronic strain of the back due to posture (pelvic tilt, increased lordosis) or occupation. Trochanteric bursitis secondary to protracted sciatica was sometimes the cause of persistent hip pain and cleared only after treatment of the hip also. Mechanical dysfunction of the knee placed a strain on the back by causing a limp or by just bearing most of the weight on the other limb. This was treated by stretching out flexion contracture, if present, and strengthening of weak quadriceps. In correcting a pelvic tilt the simple addition of arch support was quite effective when placed under a unilateral flat foot which was producing a functional shortening of that extremity.

V. *Gait Correction.* Limping due to weakness rather than to pain or persistent

Table 2: Results of Followup by Questionnaire in Postoperative Disc Cases

Level of Disc	Excellent	Improved	Unimproved or Worse	Total
L1-L2		2		2
L2-L3				
L3-L4	2	2		4
L3-L4, L4-L5		4		4
L4-L5	33	36	5	74
L4-L5, L5-S1	9	7	1	17
L5-S1	31	42	5	78
Total	75 (42 per cent)	93 (52 per cent)	11 (6 per cent)	179

sciatica following surgery for lumbar disc protrusion was not an infrequent occurrence. Supporting these various weaknesses in the lower extremities permitted much more rapid progress in ambulation with less rapid onset of fatigue. These supporting agents were crutches, cane, braces, arch supports. Sometimes, subtle weakness of hip abductors would permit walking only a very short distance. The use of a cane in the opposite hand protected this weakness and prevented its slowing up the resumption of activity. Electromyography was helpful in prognosis concerning muscle weakness and deciding whether the expense of bracing was warranted. A lift on the heel of a shoe was added for correction of shortening of a lower extremity.

VI. *Correction of Poor Work Habits.* A discussion with the patient about his work may bring out some positions or activities which are obviously a strain on the back and could be avoided without a too complicated rearrangement of his work.

Results

The results of treatment in these 179 cases were indicated by the patient on the questionnaire as cured (excellent), better (improved), and no better or worse (unimproved or worse). When there was any question as to classification of result the case was placed in the poorer category. One hundred sixty-eight cases (94 per cent) were either improved or had an excellent result (table 2). Only six per cent were unimproved or worse. The level of disc protrusion did not appear to be an important factor in the distribution of the number of cases in each. Table 3 lists the reasons for the poor results in eleven cases. Three had facet settling and sclerosis, four had recurrence of disc protrusion, and there was one case with each of the following: persistence of back pain with no apparent physical basis, psychoneurosis (with negative re-exploration), spondylolisthesis at the interspace above disc protrusion, and chronic back strain. In this last case pregnancy soon after surgery deterred strengthening exercises ever being started.

Eleven cases required spinal fusion (table 4) but only six cases (three per cent) came to fusion after laminotomy, the other five were performed at the time of disc surgery. All of these five cases had results that were classified as improved or excellent. Table 5 lists the indications for these fusions. Three had instability of facet joints, five had facet settling and sclerosis, two a recurrence of disc at the fourth and fifth lumbar vertebra interspace, and one had severe degenerative changes of the bodies of vertebrae with narrowing of the interspace.

Discussion

The high percentage of cases (94 per cent) obtaining good results from lumbar

Table 3: Cause of Poor Results in Postoperative Disc Cases

	No. of Cases
*Facet settling and sclerosis	3
Recurrence of disc protrusion	4
Persistent back pain (no physical basis apparent)	1
Psychoneurosis (negative re-exploration)	1
Spondylolisthesis	1
Chronic back strain	1
Total	11 (6 per cent)

*All had spinal fusion later.

Table 4: Results in Cases with Spinal Fusion plus Surgical Correction of Lumbar Disc Syndrome

	Excellent	Improved	Unimproved or Worse	Total
At time of disc surgery	4	1	0	5 (2.8 per cent)
Later	0	1	5	6 (3.3 per cent)
				11 (6 per cent)

Table 5: Indications for Spinal Fusion in This Series

	At Disc Surgery	Following Disc Surgery	
	No. of Cases	No. of Cases	No. Months After
Instability			
at lumbrosacral joint	1	1*	15 Mos.
at L4-L5 joint with spondylolisthesis	1		
Facet settling and sclerosis			
at L5-S1		1	24 Mos.
at L5-S1 and spondylolysis	1		24 Mos.
at L4-L5	1	2	6 Mos.
Recurrence of disc at L4-5		2	5 Mos.
			5 Mos.
Severe degenerative changes of bodies of vertebra with narrowing of interspace	1		
	5	6	
			Mean 14 Mos.

*Disc was at interspace above.

disc surgery is generally 10 per cent or more higher than the results reported in most series.[1-14] Only two series covered in our review showed comparable results: Woolsey and Tsang[4] had 93 per cent of private cases of lumbar disc surgery with results of "cured or improved." However, only 79 per cent of their remaining cases had these same results. O'Connell[6] reported 92 per cent of his cases following lumbar disc surgery were completely relieved or better. It is the opinion of the authors that the high percentage of good results in our series probably is due not only to good surgical technic but also to careful preoperative evaluation and the individualized postoperative care.

It is significant to note that indications for spinal fusion generally were the same whether done at time of disc surgery or some time after surgery. Careful preoperative evaluation including orthopedic consultation and roentgenograms of lumbar vertebrae with oblique views contributed to the good results in all five cases having spinal fusion at time of disc surgery. In none of the six cases which required spinal fusion some time after disc surgery were the indications for fusion present prior to disc surgery. The settling and sclerosis of facets in three of these cases did not develop until two years after disc surgery in two cases and until six months afterwards in one. In the one case in which instability at the lumbosacral joints developed, it was not at the same segmental level as the disc and didn't cause much trouble until over a year after the disc surgery. The indication for spinal fusion in the remaining two cases was recurrence of disc herniation.

Summary and Conclusion

The sparse literature concerning postoperative care following surgery for lumbar disc syndrome prompted this review of 179 cases. The follow-up period admittedly was short in some cases. Ninety-four per cent appeared to have good results. Only three per cent required fusion later. These results which compared favorably with other series reviewed were attributed to:

1. Careful preoperative evaluation.
2. Close cooperation between neurosurgeon and physiatrist during the early postoperative period.
3. Individually prescribed treatment consisting of:

a. exercises for strengthening weak muscles in lower extremities as well as in the trunk and for correction of contractures,
b. posture correction including weight reduction,
c. limitation of activities,
d. treatment of associated disorders and
e. correction of gait with crutches, cane, brace, or heel lift.

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Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.

When people have to obey other people's orders, equality is out of the question.

— GILBERT

Motor Nerve Conduction Velocity in "Idiopathic" Polyneuritis

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● Twenty-two cases of "idiopathic" polyneuritis were followed up to three years with periodic motor nerve conduction velocity and electromyographic determinations. In all cases a reduced conduction velocity was valuable in the diagnosis. The decreased velocity preceded the electromyographic changes by one to two weeks and gradually increased paralleling clinical recovery, although, in several prolonged cases, it did not return to normal values. Frequently a temporal dispersion of the muscle action potential was the first indication of a reduced velocity. Supporting clinical data, biopsy studies, and a brief review of the literature are included.

Considerable confusion surrounds the concept and diagnosis of idiopathic polyneuritis. In fact the terminology is highly variable, with the most common usage including Landry-Guillain-Barré Syndrome, acute infectious polyneuritis, virus encephalomyelitis, infectious neuronitis and idiopathic polyneuritis. We prefer the last term since the etiology is still obscure and the onset may be insidious. The purpose of this paper is to show the value of motor nerve conduction velocity determination in the diagnosis of this condition.

Review of Literature

Since Osler[1] in 1892 described his "acute febrile polyneuritis" there have been as many as 30 names found in the literature, as many investigators tried to clarify this clinical symptom-complex.

In 1859, Landry[2] made his original communication of 10 cases, five of his own and five previously reported in the literature. He described the course in which the paralysis could be preceded by a feeling of fatigue, tingling and sometimes transitory cramps. The first symptom was usually manifested in the distal portion of the extremities, most frequently in the lower. The paralysis then ascended up the legs to the trunk and up the arms to the shoulders and finally involved the respiratory muscles. If the paralysis disappeared the regression was in the reverse order of the progression, that is recovery proceeding proximally to distally. Death could occur in a few hours or two or three days if the respiratory muscles were affected. Of the 10 cases described, only two were fatal. Landry indicated that the sensory symptoms and signs were usually minimal, but it was possible for sensation and motor function to be equally involved.

After a small epidemic of polyneuritis observed in the Allied Armies in France during the first World War, Guillain, Barré, and Strohl[3] published their observations on two patients. They pointed out three distinct peculiarities observed in these two patients: a high protein content of the spinal fluid without a marked increase of cells (albuminocytologic disassociation), a preponderance of motor weakness and a remarkably rapid and complete recovery of the patients despite their initial serious appearance.

In 1936, Guillain[4] refused to accept as part of his syndrome the 30 cases of acute infectious polyneuritis described by Bradford, Bashford, and Wilson.[5] This study showed a mortality of 26.6 per cent and a spinal fluid free from cells and without abnormalities in the four patients in which it was examined. He also refused to accept Taylor and McDonald's[6] 16 patients because of the facial diplegia which they presented. In that year Guillain stated that he had not heard of a single death among the patients of his group, and that neither he nor his co-workers had seen facial paralysis accompanying the syndrome. He also noted that a protein content of from 1000 to 2000 mg. per cent in the spinal fluid was necessary.

In 1937, Guillain withdrew all his previous criteria. In addition to the

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classic, clinical form a mixed spinal and mesencephalic type with involvement of all the cranial motor nerves and a form with later mental signs were all admitted into the Guillain-Barré syndrome.[7]

Haymaker and Keonohan,[8] after an exhaustive review of the literature and studying 50 fatal cases diagnosed as Guillain-Barré syndrome, acute infectious polyneuritis, Landry's paralysis, and many others, conclude among other things that all fall into a single category, and that the disorder is characterized by a polyradiculoneuropathy which may begin in any peripheral neuron, spinal or cranial, and may be circumscribed or may be localized or widespread, and may affect predominantly motor or sensory or both to the same degree. They also indicate that it may remain a radicular disorder, or it may extend into the central nervous system at any point and may either ascend or descend. Changes in the protein or number of cells in the spinal fluid were regarded as incidental to the disorder. Histopathologically, the study of the central nervous system was unremarkable in the spinal cord, brain stem, or cerebrum, aside from mild to moderate changes in the anterior horn cells of the spinal cord and the motor nuclei of the brain. These were regarded as retrograde changes. The peripheral nervous system, on the other hand, was consistently affected, the lesions being concentrated in the spinal nerve, and extended for a short distance proximally and distally. There was insufficient material to determine the relative degree of involvement of the peripheral nerve. The sequence of pathologic changes included edema during the first three or four days, then beginning swelling and irregularity of the myelin sheaths and axis cylinders on the fifth day, appearance of a few lymphocytes on the ninth day, phagocytes on the 11th day, and Schwann cell proliferation on the 13th day. The changes in myelin, axis cylinders, and Schwann sheaths were progressive so that by the 46th day the maximum changes were present.

Carpendale[9] did conduction studies in cases of neuronitis in 1956. In 30 patients where the motor nerve conduction velocity was determined on the ulnar nerve, he found 10 with conduction velocities greater than 45 meters per second. Of 15 cases on which the median nerve was tested, only one had a conduction velocity over 45 meters per second.

Lambert made conduction determinations in 10 children diagnosed as infectious neuronitis, reported by Peterman, et al,[10] in 1959. He found that the muscle response to maximal stimulation was reduced in magnitude, often the response of a muscle was greater when the nerve was stimulated near the muscle than when it was stimulated at a distance from the muscle, and the velocity of conduction in the excitable motor fibers of the nerves was normal or slightly reduced in patients examined during the first few weeks of their illness but was definitely below the range of normal values in patients examined eight to 50 weeks after onset of the illness.

Procedure

Most of the examinations were done with assembled laboratory components described by Olsen and Johnson.[11] In the remainder the determination was done with commercially available instruments. The motor nerve conduction velocity determination is a relatively painless procedure where the cooperation of the patient is not needed. We stimulated the ulnar, median, peroneal and tibial nerves percutaneously. Conduction velocity was measured between two points along the trunk of the nerve, i.e. from the elbow to the wrist for the ulnar and median nerves, and from the knee to the ankle for the peroneal and tibial nerves. The latency of muscle response was measured in milliseconds, and then divided into the distance between points of stimulation. The conduction velocity was expressed in meters per second. The duration in milliseconds of the muscle action potential from the take-off to the maximal positive deflection was also noted.

Sixty per cent of our patients were male and the ages ranged from six months to 67 years, the majority of the patients being children. The onset of weakness was acute in 52 per cent of

Table 1: Conduction Velocity and Duration of Action Potentials in Normal Patients and Patients with Idiopathic Polyneuritis

	Conduction Velocity of Motor Fibers (Meters per Second)		Duration of Action Potential (Spike) (Milliseconds)	
	Normal	Idiopathic Polyneuritis	Normal	Idiopathic Polyneuritis
Nerve	Mean St. Dev.	Mean St. Dev.	Mean St. Dev.	Mean St. Dev.
Ulnar	55.1 ± 6.4	27.2 ± 4.6	6.5 ± 1.4	12.6 ± 4.2
Peroneal	50.1 ± 7.2	27.3 ± 8.6	6.6 ± 1.5	9.8 ± 3.7
Median	53.0 ± 6.4	21.4 ± 9.1	6.1 ± 1.2	10.5 ± 1.1

the cases. About one-third of the patients had a history of a previous infection, usually a few days to a few weeks prior to the onset of weakness. The most common first complaint was weakness of the lower extremities. This occurred in 64 per cent of the cases. The remainder, except for one case, noted weakness of both upper and lower extremities at onset. Cranial nerve involvement was present in three patients, two having weakness of the facial muscles, and one having weakness of the swallowing muscles. All made a complete recovery.

Objective sensory changes were observed in about one-fourth of the cases. These included reduced position sense and hypesthesia most frequently. At no time did the sensory changes appear as profound as the weakness. In most instances the patients complained of muscle pain. The deep tendon reflexes were decreased to absent in all except one case in which they were normal. Of the 18 cases with spinal fluid examinations, 15 had elevated protein and three were normal.

Nerve and muscle biopsies were done in two cases. The histopathologic studies were done in the Columbus Psychiatric Institute in Columbus, Ohio. Myelin degeneration and degeneration of the axons as represented by fragmentation and round cell infiltration were observed. These changes are compatible with the diagnosis of idiopathic polyneuritis.

Results

A total of 114 determinations were made on the ulnar, median, peroneal and tibial nerves during three years on 25 patients.

The means and standard deviations of the initial diagnostic determinations are given in table 1, as are the means and standard deviations of the duration of the muscle action potential. Electromyographic examinations were done on all patients, and after the 18 to 21 days showed a typical neuropathic picture.

Discussion

Normal values for motor nerve conduction velocities are present in the literature.[9, 12, 13] All of the initial values obtained on our 25 patients were reduced by approximately 40 per cent. This determination has been shown to be reduced in diseases affecting the axon.[9, 10, 12] It is reasonable to conclude that idiopathic polyneuritis alters the conductivity along the axon, thus reducing the conduction velocity.

There are several advantages to this examination: first, reduction may occur before electromyographic evidence of denervation has appeared; second, it does not require the cooperation of the patient and thus is extremely valuable in young children; and, third, it is normal in poliomyelitis,[14] a condition frequently confused with idiopathic polyneuritis. Sensory findings were infrequent in our series thus making the disease even more difficult to diagnose.

The first indication on nerve stimulation of altered excitability of the motor fibers was usually a temporal dispersion of the muscle action potential (fig. 1). This occurred when the stimulating electrodes were at the knee or elbow. As the point of stimulation approached the muscle, the dispersion of the action potential became less apparent. This was expected since the distance the impulse travels is so short the dispersion has no chance to appear. The temporal dispersion usually is manifested by a ragged

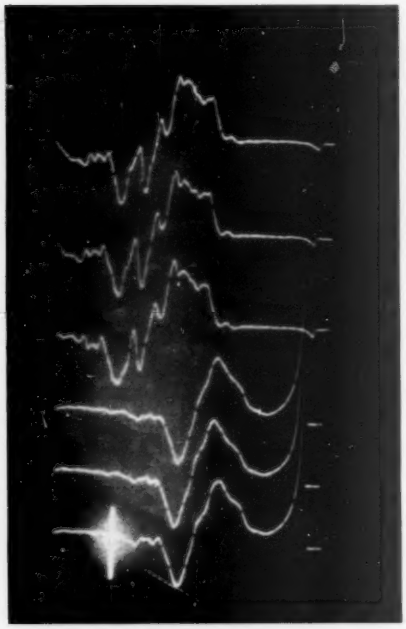

Fig. 1 — Motor nerve conduction determination of the right ulnar nerve 10 days after acute onset of generalized weakness. Note the temporal dispersion of the muscle action potential when the nerve is stimulated at the elbow. Conduction velocity is 16.5 meters per second. Calibration: 5mv., 1 msec. intervals.

appearance of the muscle action potential and increase in duration. It may be present as early as one week after onset of weakness. As clinical recovery proceeded, the motor conduction velocity lagged behind and in several cases remained reduced 20 per cent to 30 per cent in spite of no clinical weakness. This occurred in those patients who had weakness for more than several months. In those patients who recovered in several months, the conduction velocity usually returned to normal. In one case the conduction velocity dropped only 20 per cent of normal, however this was associated with definite temporal dispersion of the action potential.

A short case history will illustrate the value of this examination.

J. K., an eight and a half-year-old white male, was admitted to Children's Hospital, Columbus, Ohio, with generalized weakness for two days. One week prior to onset of weakness he had low grade fever and sore throat.

Physical examination showed symmetrical weakness of the upper and lower extremities and no sensory deficit. Deep tendon reflexes were normal. All laboratory studies were normal. Electrodiagnostic studies performed three and one-half weeks after onset of weakness indicated diffuse neuropathic disease with conduction velocity in the peroneal nerve of 28.5 meters per second.

He was followed as an out-patient for three months with repeated conduction velocity determinations of the peroneal nerve, the last of which was 44.2 meters per second. At that time there was no significant clinical weakness.

Summary

Twenty-five patients with idiopathic polyneuritis were reviewed. All patients had motor nerve conduction velocity studies performed at various stages of their illness. The values were usually reduced to below 40 per cent of normal in the initial examination and paralleled clinical recovery, although some lag was present if weakness persisted for more than several months. Temporal dispersion of the muscle action potential was the first indication of a reduced velocity. In all patients the motor nerve conduction velocity determination was either diagnostic or confirmatory.

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Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.

I is the first letter of the Alphabet, the first word of the language, the first thought of the mind, the first object of affection. In grammar it is a pronoun of the first person and singular number. Its plural is said to be We, but how there can be more than one myself is doubtless clearer to the grammarians than it is to the author of this incomparable dictionary. Conception of two myselves is difficult, but fine. The frank yet graceful use of "I" distinguishes a good writer from a bad; the latter carries with it the manner of a thief trying to cloak his loot.

— Excerpt from the "Devil's Dictionary"
by AMBROSE BIERCE

Special Appliances for the Disabled

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● This paper describes a brace for the upper extremity, with attachments for eating, writing, shaving and brushing the teeth. The brace is partially a Georgia Warm Springs Foundation type with the addition of a "C"-bar and an opponens bar. The adaptive equipment is fastened to the brace at two different points, using a double key-hole type of fastening slot. The spoon for feeding is fashioned after a scoop shovel and is fastened to the brace by a swivel joint which allows gravity to keep the spoon level on the way from the plate to the mouth, decreasing spillage from the spoon. A "stop-bar" is arranged so that pressure can be afforded against this bar, holding the spoon so that it is more stable when food is scooped from the plate onto the spoon. The plate is equipped with a metal band to hold the food on the plate against the pressure of the edge of the spoon. This metal plate guard is held to the plate with a metal clip in a stronger manner than with plastic. Two attachments for writing include a "sliding bar" and a pencil holder. A metal holder is provided for an electric razor, and this holder can be swiveled to allow a better positioning on various parts of the beard. An attachment for the tooth brush allows swiveling and various positions for brushing the teeth on both sides of the mouth.

A task of prime importance in physical medicine is that of devising the best possible self-care aids. This applies to special adaptive equipment for the upper extremities of spinal cord injury patients.

Patients with spinal cord injuries at the clinical level of the fourth, fifth, and sixth cervical vertebrae have, initially, often a complete inability to move even the shoulders. After a period of a few months, when the patient first gets up in a wheelchair, a Georgia Warm Springs Foundation Balanced Forearm Orthesis may be useful, and after another few months, as the edema of the spinal cord subsides, the active movement of the shoulder and elbow may improve sufficiently to allow the patient to use a forearm brace with functional attachments such as we are describing. This brace basically is a Georgia Warm Springs Foundation forearm long opponens hand splint with an added feature, a "C"-bar.[1-8]

This paper deals with the detachable interchangeable appliances for eating,

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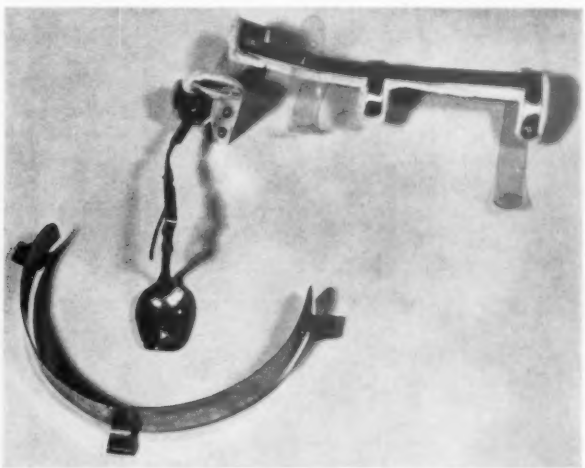

Fig. 1 — Illustrates special attachments for feeding. The bar which holds the spoon is fastened to the brace by means of a slot which slides onto the shanks of two small bolts placed on the superior surface of the "C"-bar. The bend in the middle third of this bar for holding the spoon must be twisted and bent to the exact proper position for each individual patient. The spoon has a special shape resembling a small scoop-shovel and about 3 cm. along the handle is a swivel joint, allowing the force of gravity to keep the spoon level on the way from the plate to the mouth, thus decreasing spillage from the spoon. On the ulnar aspect of the spoon is a special "stop-bar" arranged so that the side of the spoon-handle can be pressed against it. The metal plate guard attaches to the edge of a plate by means of the three metal clips. The metal plate guard holds the food on the plate against the pressure from the edge of the spoon. The metal clips and band can be adjusted easily by bending and have proved to hold the guard on the plate in a superior manner to plastic.

Read at the 3rd International Congress of Physical Medicine, Session on Medical Problems Diagnosed or Treated by Physical Medicine, Washington, D. C., August 26, 1960.

writing, shaving and brushing the teeth which can be added to this brace (figs. 1-4).

The illustrations show that the detachable appliances are fastened to the brace at two different points, using a double key-hole type of fastening slot on the radial aspect of the opponens bar and a sliding slot on the superior surface of the "C"-bar. The shape of the spoon has been changed. It resembles the shape of a small scoop shovel. The spoon is fastened to the brace by means of a swivel joint, allowing the force of gravity to keep the spoon level on the way from the plate to the mouth, thus decreasing spillage from the spoon. An additional feature which stabilizes the spoon when scooping food from the plate onto the spoon is the "stop-bar," arranged on the side of the spoon, so that the spoon can be pressed against this bar. The plate is equipped with a metal band to hold the food on the plate against the pressure of the edge of the spoon. The metal plate guard is held to the plate with three metal clips which have proved to hold the guard on the plate in a superior manner to plastic.

The attachment for writing includes a "sliding-bar," in order to allow the sliding motion of the forearm in writing, and also provides an attachment to hold a pencil. The construction of these items is shown in the illustrations. The metal holder for the electric razor can be swiveled, allowing adjustment of the razor to the various curves of the face. Similarly, the attachment for the tooth brush can be rotated in order to attain various positions for brushing the teeth.

Later on in the patient's rehabilitation, strength in the wrist extensors may improve to the point where sufficient passive flexion of the fingers accompanies wrist extension, permitting the patient sufficient passive grip for the use of still lighter equipment, eliminating the necessity for this brace, but at the proper time, and at the stage of physical improvement described above, this equipment has proved useful.

Fig. 2 — Illustrates the attachments for writing. The "sliding-bar" attachment underneath the brace permits the sliding motion of the forearm on the writing board or writing surface. The "sliding-bar" is attached to the brace on the radial side of the opponens bar by means of the double key-hole type of fastening slot. The pencil holder attachment is fastened to the brace by means of the sliding slot and the two small round-headed bolts seen on the superior surface of the "C"-bar.

Fig. 3 — Illustrates attachments for brushing the teeth. It is fastened to the brace as illustrated on the superior surface of the "C"-bar. Note the swivel joint provided for rotating the tooth brush to any desired position and the thumbscrew for holding it at the desired position.

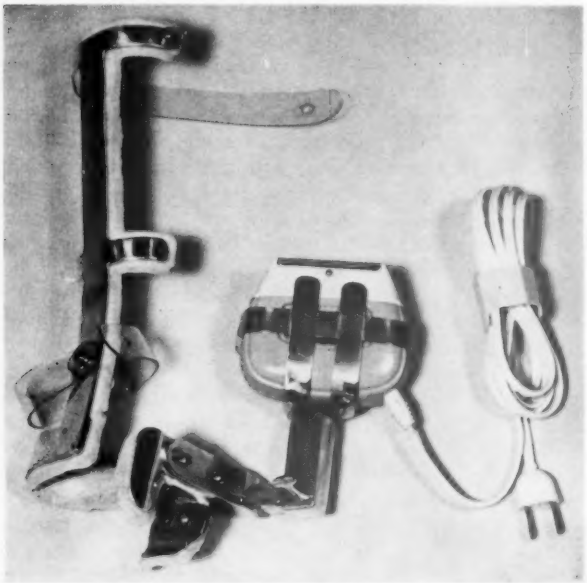

Fig. 4 — Illustrates attachment for shaving. The electric razor holder is attached to the brace at the radial side of the opponens bar by means of the double key-hole type slots which fit onto the shanks of the two small round-headed bolts. The thumb screw stabilizes any desired position of the first swivel joint. The second swivel joint is at a ninety degree angle or plane to the first swivel joint and the spring steel arrangement allows adjustment of position to the various curves of the face as desired.

Summary

A special appliance for the disabled upper extremity of a quadriplegic patient with a lesion at the fourth, fifth and sixth cervical vertebrae with about 55 to 60 per cent function at the shoulder and elbow has been described. This forearm brace, with attachments for self-care features, has proved to be a useful development for improved function of the disabled upper extremity.

Acknowledgments: The author is grateful to Mr. John C. Greene, Supervisor, Orthopedic Brace Shop, who devised these new features; to Mrs. Helena D. McBride, Supervisor, Occupational Therapy Clinic for the Spinal Cord Injury Service, who trained the patients in the use of this equipment; and to Mr. Timothy Dodge, Chief, Medical Illustration Service, VA Hospital, Long Beach, Calif., who provided the illustrations for this paper.

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A Review of the Physiology, Measurement and Management of Spasticity

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● This paper attempts to summarize the present state of our knowledge of spasticity. It contains a short historical resume of the work of many investigations in the field. The most widely accepted theories of the neuromuscular physiology of spasticity are explained with a discussion of facilitory and inhibitory mechanism, descending pathways to muscle, the organization within the spinal cord of mono and polysynaptic junctions and the antidromic stimulation mechanism. Various methods of measuring spasticity are reviewed. In addition, the numerous factors which increase or decrease spasticity, most of them difficult to evaluate, and less well known factors which influence the spasticity syndrome such as emotions and weather, are summarized. A review of the treatment technics, surgical and nonsurgical, is included. Conclusions of the study are that (1) our present knowledge of spasticity is highly theoretical and further studies are necessary on its physiology; (2) at present, no single satisfying method of measurement of spasticity is available; clinical impression still is the best method for evaluation, if well recorded, and (3) no single form of surgical treatment accomplishes, in a satisfactory way, relief of spasticity. The best medical methods relieve spasticity in a transitory fashion, but are of special importance in prevention and treatment of complications. Injection of peripheral nerves with procaine offers some hope as do various muscle relaxants, but the authors feel that satisfactory resolution of the basic problems of physiology and measurement will be necessary before definitive conclusions can be derived.

Methods for the management of spasticity are being introduced at an awesome rate. The dilemma of the physician engaged in the treatment of this disorder led us to review the literature on spasticity pertaining to physiology, measurement, and therapeutic technics.

Spasticity defied definition in the purely physiologic and technical sense.[1, 2] The term does have real meaning to the clinician as a rarely beneficial and commonly deleterious symptom complex consisting of (a) increased resistance by skeletal muscles to passive movement; (b) clonus; and (c) hyperactive stretch reflexes. Mass reflexes might also be considered therapeutically if not physiologically with spasticity as a pathologic form of motor hyperactivity.

Physiology

The concept of levels of nervous system organization as introduced by Herbert Spencer and further refined by Hughlings Jackson have been of significant value in the early understanding of motor mechanisms. It was Claude Bernard who evolved the principle that lack of control by higher centers led to excessive activity of lower centers. Sherrington and his co-workers called attention to the critical importance of input from events occurring in muscle as triggering mechanisms in the maintenance of muscle tone.[3] Summarizing the general principles of motor behavior, Denny-Brown[4] states: "Every motor reaction has an adequate stimulus immediate or remote; all that is known of motor function indicates that the nervous system as a whole contributes to each motor act." Spasticity represents motor hyperactivity in response to movement. An explanation of its physiology involves an analysis of those factors which are thought to increase facilitory or decrease inhibitory influences on motoneurons. Sensory fibers if they are to figure significantly in the production of spasticity should be stimulated by movement of the spastic limb, and afferent impulses should result centrally in the facilitation of the motor pools of spastic muscles.

Much of this synthesis of information with regard to muscle activation was taken from Eldred's splendid review of *Posture and Locomotion* contained in *Handbook of Physiology, Vol. II*.[5] The afferent nerves from muscle are the anulospiral and flower spray endings of the muscle spindle and the tendon organs of Golgi.[6] When the muscle is stretched, the anulospiral endings discharge producing facilitation of extensor contractions. When the muscle rapidly contracts, the tendon organs discharge leading to inhibition of homonomous and synergistic muscles. Each ending exerts reciprocal effects on the opposing muscles. The anulospiral endings thus are principally responsible for motor activity in response

From the Kenny Rehabilitation Institute.

Read at the 3rd International Congress of Physical Medicine, Session on Cerebral Palsy, Washington, D. C., August 25, 1960.

to stretch. In the intact animal, the net effect of all muscle afferent influences is inhibitory. However, only slight changes in experimental conditions such as cooling can cause facilitory dominance.[5]

Joint receptors fire with the flexion-extension or rotation of joints. Their role is imperfectly understood but present evidence in spinal animals would indicate that their bias is in favor of inhibition of extensor responses and facilitation of flexor ones.[5]

Cutaneous receptors are of less importance in the regulation of motor activity except as they contribute to the over-all irritability of central neuron pools and the dispersion of neural impulses. Mechanoreceptors exist in the skin, the stretching of which leads to contractions of underlying muscles. Stimulation of cutaneous surfaces by cold may lead to extension.[5] Trophic skin ulceration enhances flexion reflexes and may even cause a loss of extensor reflexes such as knee jerks.

Entero-receptors may be stimulated by shifts in the position of viscera in response to changes in posture. The discharge of the visceral receptors in the upright position favors the contraction of abdominal flexors and the psoas. In man, the knee jerk is facilitated with strong visceral contractions.[5] The extreme facilitation of reflex activity which occurs with visceral infections in the spastic man is notorious.

The anulospiral endings in the muscle spindle are unique among all sensory organs in most directly and intensely influencing the response of muscles to stretch. These endings are likewise unique in that their sensitivity is enhanced by contraction of the muscle spindle in response to gamma motoneuron activity. In fact, the simultaneous contraction of muscle spindles and extrafusal muscle fibers may actually lead to an increase in discharge from anulospiral endings despite muscular contraction which would under normal circumstances lead to unloading of muscle spindles. The threshold for gamma motoneuron activation is lower than that for alpha motoneuron effects.[5]

Central control of muscle tone modulates ever changing afferent activity to form a steady efferent discharge. Sensory inflow over any dorsal root effects activity at distant levels as well as that of the specific segment. The palmomental reflex so common in hemiplegia shows twitching of skin of the chin in response to scratching the palm.

Because of the dispersion of afferent impulses, the incidence and intensity of reflex activity increases with the length of isolated cord segment in the spinal animal or with the number of dorsal roots remaining in a partially deafferentiated preparation.

Vestibular inflow exerts a powerful, unfatiguing facilitation on antigravity muscle activity. The reticular formation exerts a steady influence upon segmental reflexes and tonic contractions.[7] The nature of descending reticular influences may be either inhibitory or facilitory depending upon reticular input which arises from a variety of origins including vestibular organs, muscles and joints.

In summary, it can be seen that the motor behavior of the spastic animal is dependent upon the sum total of sensory impulses arriving from the periphery. The response of the organism to these impulses is dependent not only upon the nature, location and intensity of the afferent stimuli, but upon the status of those competing elements of control which are responsible for raising the threshold to coarser stimuli.

Measurement

Numerous attempts have been made to measure spasticity. The fascinating history of technology utilized and problems encountered in accurately assessing "muscle tonus" began with Lombard in 1887. These studies and subsequent early methods involved relating variations in deep tendon reflexes to "muscle tonus." McKinley in 1928[8] developed one of the first of what has been a long series of elaborate devices for quantitating "muscle tonus." His gadget recorded the pull of muscles about the elbow joint as it was passively flexed and extended. It was McKinley's observation that there were significant differences in the behavior of muscle tonus among normal individuals. He classified people into "phlegmatics"

and "excitables." Equally complex and perhaps increasingly accurate devices for measuring the resistance offered to passive motion by muscles have been described.[9-13]

Among the more recently developed technics are those of Stillwell and Gersten[14] which measure the force required to initiate motion in a spastic extremity. Extensive use of electronic equipment has allowed for several new approaches such as Erdman's analysis[15] of muscle tension and electrical potential of muscle activity while applying a mechanical force of known magnitude to the tendinous insertion, or Gammon's approach[16] which utilizes an electronic analyzer to record displacement velocity and acceleration of a light passing from subject to a photoelectric cell.

Several attempts have been made to quantitate spasticity by means of electromyography.[17-22] These studies on various disabilities have shown that the electromyography does have value in measuring spasticity but must be heavily supplemented with clinical observations to become meaningful.

There has not emerged from the attempts to date any satisfactory method for quantitating spasticity. The problems encountered are related to the fickle quality of spasticity's dimensions rather than to inaccuracy of the measuring instruments. W. Heisenberg's principle of uncertainty states "Every measurement whatever the method of its employment invariably interferes more or less with the event to be measured."[23] This is certainly true when applied to the nervous system which must inevitably respond to the very act of being measured.

Spasticity's magnitude depends not only upon the measuring forces — speed, intensity, location and duration — but also with the position of distant extremities, room temperature, the fullness of the subject's bladder, the presence of decubiti and perhaps even the personality of the measurer's assistant. Flanders Dunbars noted that "changes in muscle tonus are among the most frequent mechanisms of psychologic expression."[24] George Hohmann has even reported an increase in spasticity in response to emotional stimuli in patients with complete anatomic lesions of the spinal cord. Since the phenomena to be treated cannot be accurately assessed with any mechanical contrivance, the subsequent comments which we shall make relative to the value of therapeutic measures are of necessity based on clinical and empirical observations.

Physical Measures of Management

Heat is probably the most widely used of all physical therapeutic technics. Euler[25] has reported that the activity of gamma fibers decreases with the raising of body temperature. The reader is referred to articles by advocates of different forms of heat application such as hot packs,[26] paraffin baths,[26] infrared radiation,[27, 11] diathermy,[13] or heat combined with hydrotherapy.[28, 29]

Cooling has fewer exponents than heat. Cooling has been achieved by applying hydrotherapy at temperatures ranging from 80 to 50 F., ice packs for a period of 10 to 15 minutes,[30] and ethylchloride spray.[31]

Massage in the form of stroking and kneading provides some relief from spasticity.[32, 33] Passive mobilization, stretching, coordination and strengthening exercises are of significant value. Various forms of proprioceptive facilitation and reflex therapy as employed by Kabat,[34, 35] Fay,[36, 37] Levine,[38, 40] Bobath,[41] Phelps, Perlstein and others,[42] have a very real place in the management of spasticity. These technics utilize the close interrelationship between voluntary motion and reflex activity and make an attempt to inhibit or facilitate various reflexes. It is our impression that these technics by profoundly influencing the nature of afferent barrage reaching structures such as the reticular formation and ultimately the motor neurons, are capable of significantly modifying motoneuron activity.

Electrical stimulation in the form of tetanizing current to spastic muscles[43, 44] to their antagonist[45] or combinations[13] of the two have been tried. Attempts at electrically stimulating the brain in spasticity are reported to have produced favorable results. Stillwell and Gersten[46] have studied the effects of ultrasound. The same authors, basing their work on

the physiologic observations of Gilliat and Bentley, observed that ischemia produced by a blood pressure cuff produced temporary relief of spasticity.[14, 47-50] Cuff pressures of 200 mm. of mercury were applied for period of time from 10 to 20 minutes. Jousse has been unable to confirm the value of this technic.[29] Spas employing physical therapeutic measures combined with optimal psychologic and climatic conditions as well as possible metabolic changes are said to be beneficial for the treatment of spasticity.[51, 52]

Bracing is one of the more controversial aspects of the management of this disorder with some authors maintaining that braces are effective in relieving symptoms and others claiming that stretch reflexes are actually magnified by the use of braces.

Surgical Management

The surgical attack on spasticity began very early and has been extended to all levels from cortex to various tracts, afferent and efferent roots, peripheral nerves, muscles and tendons. Browder[53] observed during the course of surgical excision of cortical areas for the relief of epilepsy, that some of his subjects had a reduction in spasticity. One of these patients experienced relief of spasticity after excision of almost the entire right parietal lobe. Hemispherectomies performed on individuals with severe and prolonged cerebral lesions have been shown to reduce spasticity. Bucy,[54, 55] basing his technics on the physiologic studies of Fulton, confined his surgical excisions to areas four and six with dramatic temporary results, but with recurrence within two weeks after operation.

Operative procedures on the spinal cord have in general been more successful and provided more lasting, though by no means always permanent, relief in the reduction of spasticity. Spasticity originating from both cerebral and spinal cord lesions has been attacked by means of excision of the cortical-spinal tract[56] vestibulospinal tract[57] and reticulospinal pathways.[58, 59] In most instances reduction of spasticity when it did occur was of short duration.

Posterior rhizotomies were performed as early as 1910 with results of 81 cases having been reported on in 1911.[60, 61] In this procedure, incomplete lesions result in recurrence of spasticity whereas complete ones, if no supraspinal pathways remain, produce complete flaccid paralysis. Anterior rhizotomy[62,63] has enjoyed more recent popularity having been used extensively in individuals suffering complete cord transection during World War II and is still widely practiced. The severed roots generally consist of the tenth or twelfth thoracic vertebra to the first or second sacral vertebra. More careful selection of cases has reduced the number of individuals on whom this procedure is employed although it still has a very real place in the treatment of spasticity interfering with rehabilitation.

Subarachnoid injection of alcohol has likewise had widespread recent use particularly in the treatment of traumatic paraplegics.[64-66, 29] One of the principle virtues of this technic is its simplicity. Spinal anesthesia has been applied as a preliminary evaluative measure prior to actual injection of alcohol. Neuromyotomies are useful principally in incomplete lesions.[67,68] Unilateral or bilateral obturator neurectomies supplemented with adductor tenotomy can be helpful in individuals when adduction and flexion at the hip joint interferes with the accomplishment of activities. Section of the psoas tendon and femoral nerve can be added to the foregoing procedures in more severe cases. The combinations of effective procedures are too numerous to mention in this review.[67] Sympathetic gangliectomy has only historical interest.[69, 33]

The application of procaine to peripheral nerves still is in the very early stages of development but initial results would seem to indicate that this is a promising technic. It has been used on the sacral roots and reports of followup on cases treated by Munro after visualization of the nerve are anticipated. The critical limiting factors in most of the more effective and incidentally, more destructive, surgical lesions, include loss of ability to walk utilizing spastic knee extensors in paraplegia, loss of automatic

bladder function and increasing edema of the legs secondary to reduced venous return.[29, 67]

Drugs

Real advances have been made during the last 15 years in obtaining drugs which significantly reduce spasticity. The ideal drug should reduce spasticity and should have no effect on normal movement, low toxicity, no undesirable side effects, prolonged action and should be non-addicting. None of the compounds in use today can meet all of these conditions. Curare[70-72] and its synthetic derivatives through its selective action on myoneural junctions has been effective in some instances. Its short duration of action and paralyzing effect on cranial nerves and muscles of respiration seriously limit its usefulness.

Barbiturates which raise the threshold for some sensory stimulation of the spinal cord as well as curtailing dispersion of sensory impulses along internuncial chains are useful.[65, 73, 74] Barbiturates also depress the activity of other components of monosynaptic pathways by increasing the degree of local depolarization of neurons and thus reduce their excitability.

Other traditionally anticonvulsant agents such as Diphenylhydantoin and Tridione[74] are known to limit the spread of activity from one part of the cortex to others as well, in some instances suppressing the activity of seizure foci. These agents in combination with other drugs have a place in the management of spasticity.

Berger's and Bradley's studies[75] of Mephenesin[76-79] and substances chemically related to it have led to the development of agents such as Meprobamate.[80-82] Similar aromatic glycerol ethers have received more cursory investigation and in 1910 were noted to produce paralyzing effects on animals. The conclusions from this group of investigations is that Mephenesin and its chemical relatives affect principally complex multisynaptic reflexes and in so doing produce weakness and incoordination. The newer agents have more prolonged action than Mephenesin and are essentially nontoxic. Several investigators have reported the successful use of Meprobamate in spastic states as well as dystonics and athetoids. Its known action on emotional activity coupled with lack of quantative results negate somewhat the value of these reports. More recently introduced agents such as Nuncital,[83] Soma,[84] and the older Thorazine are said by their manufacturers to be more potent and therefore to produce more profound relaxation over equal periods of time.

Zoxazolamine (Flexin) reportedly acts on central polysynaptic pathways and has been used with variable effectiveness in cerebral palsy.[85, 86] Toxicity, according to Millichap, is greater than that of Meprobamate.[86] There appears little doubt that there are available drugs with direct and selective action on specialized groups of neurons. These drugs by limiting the irritability of neurons as well as the propagation of impulses represent one of the most promising areas in the management of spasticity. A critical factor in the evolution of superior agents remains the lack of a satisfactory means of measuring their effectiveness.

Conclusions

Spasticity is defined as a clinical syndrome characterized by increased resistance of skeletal muscles to passive movement, clonus and hyperactive stretch reflexes. The spastic man is a victim of uncontrolled sensory influences, most of which aggravate his reflex activity. The optimal state of affairs would seem to be a moderate domination of postural or extensor reflex activity which is possible only through early effective nursing and physical therapeutic measures designed to control afferent stimuli. Careful, frequent clinical observations are superior to any mechanical or electronic devices for measuring spasticity. The relative effectiveness of any form of treatment can be expected to vary greatly in different spastic individuals. The successful management of spasticity is at present a trial and error process utilizing physical measures, surgery and drugs.

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Don't hit at all if it is honorably possible to avoid hitting; but never hit soft.

—THEODORE ROOSEVELT

Critical Factors in Electromyographic Instrumentation

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● The design of an instrument adequate for clinical electromyography should be dependent upon the parameters of the bioelectrical phenomena to be recorded. A critical review of current instrumentation is offered with pitfalls of possible faulty interpretation.

Demonstration and recording of muscle action potentials require apparatus having certain electrical and mechanical characteristics. An appreciation of the electronic principles involved and of the limitations of the equipment should help avoid misinterpretations and pitfalls. The design should be such as to adequately reproduce the electrical characteristics of the biologic phenomena involved.

The parameters of the potentials involved include pulses with durations of less than one millisecond and voltages as small as 10 microvolts or less (fibrillation potentials). Potentials up to 20 or 30 milliseconds also are observed (positive sharp waves). Complex wave forms with amplitudes as high as several millivolts are not infrequent.

To properly display and record these potentials, the apparatus must be so designed as to reject interference maximally and have a suitable frequency response. Correct matching of impedances must be observed.

In simple terms, the electromyograph consists of an amplifier connected to the patient by means of electrodes. The amplifier is necessary to increase the action potentials to a level suitable for observation and recording. The original level of the potential differences picked up by the electrodes vary from less than 10 microvolts to several millivolts, the average being several hundred microvolts. Amplification of very small potential differences to recordable levels (volts instead of microvolts) would present no problem, since it is quite easy to amplify voltages using either multi-electrode tubes or transistors, were it not for interference. If it were possible to record in an area isolated from other electrical fields, much of this interference would be absent. Other sources of interference cannot be avoided and result in so-called "noise." This is due to the uneven flow of current in conductors, the uneven emission of electrons in vacuum tubes (shot effect) and other similar sources. The minimum noise level possible is determined by several factors among which are the frequency response and the input impedance of the amplifier. In amplifiers used for electromyography, the noise level varies between five and 10 microvolts.

Rejection of Interference. Interference due to stray electric fields can be greatly reduced by using a differential amplifier.[1] Inherent noise is the limiting factor in amplification. The ability of this type of amplifier to discriminate against the interfering voltages is expressed as the rejection ratio. This ratio should be as high as 10,000 - 50,000 to one. The simple expedient of grounding the patient also greatly reduces the interference. In spite of high rejection ratios, a cage is usually required for convenience and to avoid interference. The cage must be grounded at one point only. This usually precludes the inclusion of the screening within the walls of a room. It is also necessary that the electromyograph be connected to the same ground as the cage. Failure to observe these precautions leads to the establishment of ground loops and an increase rather than a decrease of interference. With a well constructed and well located

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Read at the 3rd International Congress of Physical Medicine, Session on Electromyography, Washington, D. C., August 23, 1960.

cage, grounding of the patient may not be necessary. Besides being convenient, it reduces the pick up of "distant" potentials.

Input Impedance. Input impedance refers to the effective resistance at the input of the amplifier to various modes of alternating current. This depends not only upon the actual physical resistance which is placed in the circuit, but on the intensity of grid current and capacitative effects including those due to proximity of circuit elements. The lower the input impedance, the less noise will be observed in the output circuit. It would therefore appear desirable to have as low an input impedance as possible. Unfortunately, in order to get faithful response from the amplifier, it is necessary that the impedance at the input of the amplifier be equal to or greater than that of the generator. The electrodes can be considered as the generator. If the impedance of the generator exceeds that of the input of the amplifier, marked distortion and loss of high frequency response will result (fig. 1). This loss of high frequency response has no relation to the fact that measurement taken with an oscillator might show very excellent frequency response since the oscillator may have a low output impedance. The usual impedance of a coaxial needle electrode is about 30,000 ohms to direct current and is greater to various modes of alternating current. Therefore, the input impedance of the amplifier must exceed 30,000 ohms. In a well designed apparatus, the input impedance is usually in the order of several hundred thousand ohms at least, and in some cases of the order of megohms.

Frequency Response. Amplifiers can be constructed to respond accurately to frequencies up to many hundred million per second. In electromyography, the changing phenomena being observed are more or less in the form of pulses. The stated frequency response of an amplifier refers to its ability to amplify variations having a regular sinusoidal mode. It can be shown by Fourier analysis that any irregular wave form is made up of sine waves of various frequencies.[2] In order to reproduce an irregular wave without distortion, all of these various sine waves must be amplified to the same extent as in the original.[3] For example, the reproduction of a square wave requires an amplifier having a frequency response at least 10 or more times the frequency of the wave itself. In electromyography, pulses as short as one millisecond or less are being measured. Therefore, a frequency response of at least 10,000 per second is desirable.

When the time constant of the amplifier is too great, undesirable blocking may occur. This usually limits low frequency response to above 20 cycles per second. In this case any slow variation of the baseline must be carefully interpreted because distortion at low frequency may be great. It is unwise to describe any potential having a slow baseline variation

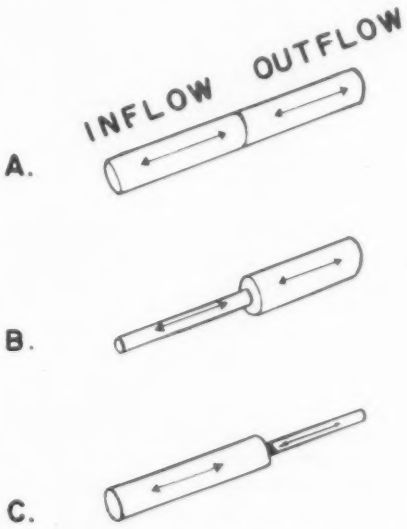

Fig. 1 — A rather simplified hydraulic example illustrating the necessity of matching the impedance of generator to that of amplifier. *(A)* If an inflow tube brings in a fluid flow which varies in a rapid manner, the outflow tube being of the same size, the variations of flow are identical in both tubes. *(B)* A tube of high resistance feeds a tube of low resistance. The high frequency response of the outflow tube will be poor, since it takes time for it to be filled. Variations occurring will not be well transmitted. Low frequency variations may be transmitted if these are slow enough to empty and fill the outflow tube. Thus distortion is greater in the higher frequencies. *(C)* The inflow tube is larger than the outflow, so that flow is transmitted with loss in the amount of fluid. Since the outflow tube remains entirely full, the variations of inflow will be transmitted without essential change. In this case, a tube of low resistance feeds a tube of higher resistance.

as actually illustrative of this potential, unless the apparatus is designed to have a low frequency response suitable for recording such a potential change.

Recording Methods. A source of inaccuracy in electromyography is exaggerated sweep width on the cathode ray tube. If the sweep width is too great, the horizontal aspect of the trace will extend beyond the confines of the tube face so that some phenomena will be heard without being seen.

There are several methods of recording and retaining information.

An oscilloscope camera, with continuous photographic recording, is the most desirable method of preserving permanent visual records. However, due to the expense of apparatus and film involved, other methods are more popular and can be quite satisfactory. A still camera is the most commonly used method in conjunction with an oscilloscope trace which is triggered for a single sweep. A spring wound camera triggered by a solenoid activated by a foot switch can take separate pictures as fast as the trigger can be manipulated. The best method for photographing a single frame is to use the flash contacts of the camera to trigger the sweep at the moment when the shutter is completely open.

Tape recording is another method of retaining information. Usually, this apparatus operates at a tape speed of seven and one-half inches per second. This should be the minimal speed. Where much greater fidelity is desired, greater speeds should be considered. The low frequency response of a tape recorder is less satisfactory than the high frequency response. It is possible to extend low frequency response even down to direct current by using certain costly systems of tape recording, such as frequency modulation.

A separate track for the voice should be included in the tape recorder. This entails the use of at least a two channel machine. This allows the voice to be included without interfering with the trace itself. If a separate voice channel is not available, speech will obliterate muscle potentials or it will be necessary to switch off the electromyograph while speaking.

Another method of obtaining continuous tracing consists of high speed tape recording, with low speed tape playback. The low speed plays back to a penwriter. Since the ratios employed are 20 - 30 to 1, the apparent frequency response of the penwriter is thus increased by 20 to 30 times. Frequency modulated systems must be employed in this case. Direct penwriting without such an advantageous arrangement is not suitable for electromyography recording. The inertia of the pen limits frequency response to about 100 cycles per second.

Electrodes. The most commonly used electrodes are monopolar or coaxial needles. Skin electrodes are only suitable for kinesiologic or conduction time studies. It has been said that the coaxial needle has "directional" properties.[4] This directionality may be more apparent than real. Its mechanism would be difficult to understand since recording is being done in a volume conductor. A monopolar needle has axial symmetry and as it is turned, the contact area at the point does not change its location. A coaxial needle having a bevel also turns about its point. If it is turned about the core as its axis, the point would have to tear through tissue as it rotated. Thus, the point of the needle remains fixed and the contact area in the lumen moves through a circumference. In effect, the central contact is changing its position in relation to the dipoles being recorded. This change in spatial position rather than change in direction is probably the reason for the observed "directionality." This may even be of advantage since searching for potentials can be accomplished by the painless process of rotating the needle.

The coaxial needle has mechanical advantages over the monopolar needle. The cutting edge of the former makes insertion much less painful. The coaxial needle is also convenient since only a single surface electrode for grounding purposes need be attached and the needle itself may be inserted without using a reference electrode. The use of a reference electrode may not be too inconvenient in doing electromyography of limbs but in the trunk or facial muscles it becomes a nuisance because of the difficulty of maintaining the reference

electrode in place. For this reason, Marinacci has suggested the use of fine intradermal needles for reference and ground.[5] A disadvantage of the monopolar needle is the difficulty in testing the integrity of the insulating coating. Areas of variable conductance develop through the use of this needle. Various schemes have been devised to test the integrity of the insulation; but none is entirely satisfactory. Recoating of the needle is not a major procedure, but it usually is neglected in practice. Testing the integrity of insulation and contact area of the coaxial needle is a fairly simple procedure.

Motor Nerve Conduction Velocity. There is growing interest in the clinical application of motor nerve conduction velocity.[6] Superficial motor nerves can be stimulated and the time elapsed between the stimulus artifact and the evoked potential can be measured. This is "total conduction time." In order to measure conduction velocity, the oscilloscope must have a calibrated sweep which can be triggered by the same pulse which is used for stimulation. A variable delay circuit must be incorporated to permit the observation of the artifact on the scope. Thus the sequence is as follows: (1) the triggering pulse starts the cathode ray sweep; (2) the variable delay circuit allows the location of the artifact of the stimulus on the scope at a known point; (3) the stimulus is applied to the motor nerve at this time; and (4) the muscle action potential then appears on the scope. The time between the appearance of the artifact and the beginning of deflection of the muscle action potential can be accurately measured since the sweep time is known.

In order to eliminate the delay due to end-plate conduction and conduction through the muscle fibers, the motor

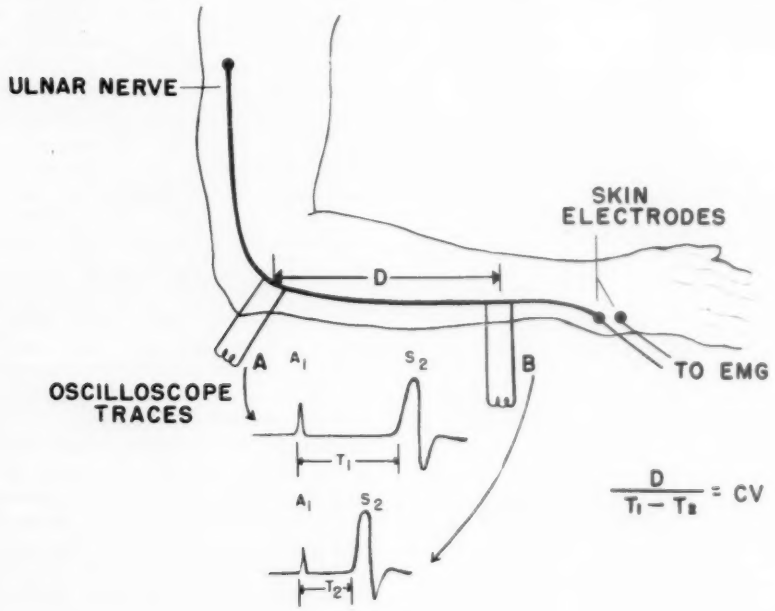

Fig. 2

A. Stimulation of Ulnar Nerve at elbow
   - A_1 Stimulus artifact
   - S_1 Action potential of abductor Minimi Digiti
   - T_1 Total conduction time

B. Stimulation of Ulnar Nerve at wrist
   - A_2 Stimulus artifact
   - S_2 Action potential of abductor Minimi Digiti
   - T_2 Total conduction time

D. Length of Ulnar Nerve between two stimulation points

nerve is consecutively stimulated at two points. The distance between these two points is measured. The time taken by the impulse travelling between these points is the difference between the two times. The formula for determining conduction velocity in meters per second, is distance in millimeters divided by time in milliseconds (fig. 2).

Total conduction velocity may be a useful clinical determination. While this is based on a single stimulation point and less accurate than that derived from the two point method, this measurement can be of practical value.

Many electromyographs are provided with facilities for determining conduction time, but some are not. In the latter, where triggered sweep and variable delay circuits are not incorporated, it may be possible to add these to the existing apparatus, or to add another oscilloscope having these facilities.

The stimulator should have pulse durations between 1/10th and five milliseconds. The shorter pulse durations are desirable and should be used where possible. The stimulator output must be entirely ground free in order to obtain a small stimulus artifact. The patient must be grounded in the area between stimulation and pick-up electrodes, and the electromyograph must have high input impedance with excellent rejection ratio. The pick-up electrodes are usually small surface electrodes, one placed over the belly of the muscle, the other over the distal tendon. Conduction time can be measured by observation. Unless the oscilloscope is of the storage tube variety, more accurate results are obtained by photography with the camera itself triggering the stimulus.

Summary and Conclusions

1. The parameters of the biologic potentials to be recorded determine the characteristics of the apparatus.

2. "Noise" level limits amplification.

3. Differential amplification reduces interference.

4. High rejection ratios are necessary.

5. The amplifier must have high input impedances.

6. Frequency response should extend at least from 20 to 10,000 cycles per second.

7. Various recording and photographic methods are discussed.

8. The advantages of the coaxial over the monopolar needle have been outlined.

9. Methods for determining motor nerve conduction velocity are explained.

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He that is greatest among you shall be your servant.

— BIBLE

The Application of Psychometrics in the Vocational Evaluation of the Adult Severely Disabled

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● A discussion of some criticisms, applications and trends in the use of psychometrics with the adult severely disabled. The widespread use, and sometimes misuse of tests, has led to the necessity for a sound methodologic framework in the vocational evaluation of these clients. In instances where instruments developed for non-disabled groups cannot be applied, emphasis is placed upon the development and standardization of tests for disabled groups. In addition, the authors report a technic, the THOMASAT, which was developed exclusively for the evaluation of cognitive-motor skills of disabled individuals as these are applied in a sheltered work situation. Current trends in this area are presented. Of particular importance is the increasing use of procedures which place minimal response demands upon the examinee; the development and modification of technics for the intellectual evaluation of the adult handicapped client and the utilization of pictorial technics especially constructed for assessment of the personality of these individuals.

Progress in the psychometric appraisal of the severely disabled has been of such an extent that these individuals, as a group, are no longer considered "untestable." Evidence of this progress is given by the fact that one of the most widely used references on psychological testing includes a brief section on the evaluation of these persons.[1]

The recommended use of standardized psychometrics in the vocational rehabilitation of the severely disabled varies from limited or no use[2] through clinical application[3] to the development and use of pure factor tests.[4] In spite of the controversy which inevitably results from a discussion of testing in this area, there is general agreement in terms of their use, in some form, in many rehabilitation agencies or centers.[5] In a large measure the conflict centers around a utilization of tests standardized on samples other than disabled ones. General consensus appears to be that the more the sample to be examined diverges from the original standardization group, the less meaning can be ascribed to test results. Consequently, instruments which may accurately gauge some trait in this original group may be reflecting some other quality characteristic of a disabled population. This consideration has not discouraged the widespread use of existing psychometrics in vocational rehabilitation because of the practical necessity, in some instances, of comparing disabled individuals to norms established on non-disabled groups.

Most workers in this field of concentration recognize the contribution of multiple factors in vocational rehabilitation of individual clients. Some of these factors, work history, attitudes, intelligence, aptitudes, achievements, interests are of special importance. Therefore, the application of psychometrics, in its proper perspective, simply provides a small amount of the information required in making vocational judgments about clients.

Theoretical Assumptions

Since evaluation of the vocational potential of disabled individuals contributes to the total rehabilitation process, it is necessary to distinguish between *evaluation for selection* and *evaluation for guidance*.

According to Warren,[6] vocational selection is "the process of choosing from a group of applicants for a vocation those most likely to succeed in that vocation." Therefore, evaluation for selection assumes the existence of a specific job or jobs and a pool of applicants from which to draw. Technics utilized in this kind of evaluation frequently include miniature

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Read at the 3rd International Congress of Physical Medicine, Session on Problems Diagnosed or Treated by Physical Medicine, Washington, D. C., August 25, 1960.

tests and/or job samples which replicate as completely as possible the elements which comprise the job under consideration. This condition permits predictions which are of a highly accurate nature although they are limited to some degree by their specific relationship to a single criterion (job). Since the process in vocational rehabilitation is seldom that of selection but rather one of counseling or guidance, the use of these selection technics would appear to be severely restricted; the restriction being imposed by the necessity of having a miniature test for each job or job family under review for the individual client. Unless the occupations within a particular locale are extremely limited in number, this is an obvious impracticality.

Because vocational guidance involves to some extent assisting clients in determining realistic vocational objectives, results are usually viewed in terms of a number of possible occupational outcomes. The situation, then, is an open-ended one in which the client is not necessarily confined in vocational choice. Therefore, the procedures used in evaluation for guidance appraise many different facets of human functioning in relation to various occupations. An outgrowth of this kind of analysis is the development of test batteries which include measures with empirically established values for certain occupations, the weight of the measures for each job being determined by its significance for that job. The General Aptitude Test Battery is reflective of this particular approach to test development and use. This battery, developed on the basis of factor analysis, is composed of measures designed to appraise aptitudes and skills required in many different jobs. This is not to state, however, that the test is adequate in all respects or that it is specially adaptable to disabled groups. It is briefly alluded to here simply as illustrative of a procedure which may prove to be useful in the development and use of vocational evaluation technics with the physically disabled.

A rather unique experiment employing psychometric procedures to the problems involved in the vocational evaluation of the physically disabled has been conducted at Highland View Hospital. Although still in the early stages of development, a test, the THOMASAT,[7] has been found to be useful in screening disabled individuals for work at various levels in a sheltered shop. This scale was constructed on the basis of an analysis of the operations required in the successful performance of various industrial jobs in the shop. It has been used primarily with disabled adults and there has been some evidence that test performance is related to job performance. Currently, although somewhat restricted in scope, this approach offers promise of a practical solution to some of the problems connected with evaluating these persons for particular jobs. It appears to be amenable to further refinement and development by factor analytic procedure.

Practical Aspects

In using psychometrics to appraise the vocational capabilities of the severely disabled it is essential to consider two fundamental conditions:

(a) the necessity for taking measurements over time, and

(b) the measures cannot be isolated from local conditions.

Since physical status is to some degree correlated with the psychologic status of an individual at a given moment in time, it can be expected that temporary fluctuations in health frequently are accompanied by alterations in mood, attitude, etc. Consequently, these changes may also affect motivation(s) for test-taking and concomitant test performance. It is not extraordinary to expect psychometric achievement to improve, in some measures, as the temporal interval from onset of the disabling condition increases; providing, of course, adequate rehabilitation procedures have been instituted and the condition is not a progressively developing one. It has long been recognized that time is an extremely important variable affecting adjustment to crippling physical disorders.

Wendland,[8] working with poliomyelitis patients, found that those examined early in their hospitalization scored lower on the verbal section of the Wechsler Adult Intelligence Scale than another group

tested at a later point in their hospitalization. Although it cannot be discerned from the data given whether the latter patients were originally better in verbal ability than the "early" group, the evidence is compatible with the view that retesting at various intervals is an exigency in the adequate psychometric appraisal of disabled clients. Neff[9] discovered that the Rorschach administered immediately upon entrance into a work program was not a good predictor of vocational rehabilitation. However, Rorschachs given after eight weeks' experience in such a program reliably discriminated between rehabilitated and nonrehabilitated clients. Therefore, in order to obtain a better estimate of an individual's optimal level of functioning it is necessary to sink critical shafts at various stages of the rehabilitation process.

The emphasis placed upon testing in rehabilitation cannot be separated from the aims and policies of the particular agency involved and the characteristics of the clients serviced. Some agencies serve one specific disability group exclusively and conversely, the clientele of many others are heterogeneous with respect to disability. There are those supported by hospitals, welfare organizations, state and federal programs, and some managed singularly as private facilities. Staff persons concerned with the vocational process vary greatly in academic training and theoretical orientation. Accordingly, the aims of a testing program, kinds of tests utilized, and the amount of testing accomplished depend upon these factors and their interrelationships.

The characteristics of the clients accommodated by a particular agency directly affects the selection of the tests to be used. Age, educational level, occupational background, and kind of disability are extremely important variables which determine the nature of the psychometrics employed. There is the possibility that some of the instruments commonly used in vocational testing may not be employed successfully because of advanced age, severity of disability, and extremely limited educational attainment. Hence, adequate test selection follows upon a serious regard for these factors.

Trends and Suggested Applications

Although as a measure of intelligence the Wechsler Tests, in some form, are used almost universally, many physical disabilities manifest themselves in terms of manual and verbal anomalies which preclude the use of instruments emphasizing these functions. As a consequence, measures for which successful performance is not dependent upon verbal skills or manual dexterity will probably find an increasing application in this area. This trend can be seen in the use of Raven's Progressive Matrices Test, Ammons' Full-Range Picture Vocabulary Test, and the Columbia Mental Maturity Scale in evaluating the intellectual status of disabled adults. On the other hand, in spite of the indications that many clients who enter rehabilitation centers are either of varied cultural backgrounds or have been restricted socioeconomically, there is virtually no *research* reporting the use of the Cattell Culture-Free Test of Intelligence or similar instruments designed to appraise this function free from the influence of cultural factors.

The Rorschach, Thematic Apperception Test, and the Minnesota Multi-Phasic Inventory continue to be the preferential technics in personality assessment. In addition, there have been modifications in the projective approaches which can be used for appraising the interests and personality patterns of the physically handicapped.[10-12] However, there is a dearth of empirical information available concerning the utilization of psychometric methods in determining personality factors relevant to occupational adjustment of the physically disabled. One possible explanation is the limited utility of the "objective" self-appraisal inventories in personal evaluations. As an adjunct to the usual apprehensions surrounding the value of these measures, there is the theoretic proposition that responses which would be regarded deviant with respect to the nondisabled may be quite appropriate and adequate for an individual with a particular physical disability.[13]

Contrasted with the theoretic notion that intelligence exists independently of verbal fluency or manipulative skill, the

testing of special abilities, motor and mechanical, requires direct performance on certain tasks. The emphasis here is not so much in determining potential functioning but current level of effective functioning. Therefore, it is plausible that performance tests, in distinction to paper and pencil tests, should play a prominent role in a testing program since many of the occupations these individuals undertake, or are capable of best performing, include special abilities of a motor or mechanical nature. Although some disabilities involve muscular incoordination of the upper extremities, these tests can be profitably employed to realistically screen individuals for occupations which include these abilities.

Research Implications

A major criticism of the use of tests with the physically disabled is that the heterogeneous nature of disabling conditions contraindicates adequate intragroup and intergroup comparisons. That is, physical nosology is not precise enough to permit the standardization of tests on specific disability groups, if any such groups at all exist. In such a broad area where there are many different kinds and degrees of physical impairment, any classificatory scheme must be rough and tentative indeed, at least in terms of our present state of knowledge. However, rehabilitation workers tend to use these rough classifications, consciously or unconsciously, as approximate guides to treatment. Examples of such functional descriptions or categories are "the cerebral palsied," "the paraplegic," "the polio," "the hemiplegic," etc.

Insofar as the application of psychometric procedures is concerned, it is possible to identify two kinds of experimental situations which bear directly upon this criticism. The first situation methodologically equates, as far as possible, subject differences with respect to important physical variables. This involves the use of measures which minimize the response demands made upon the examinee in an attempt to study the degree of, or potential for, some psychologic function. In this instance the degree of physical disability itself is not allowed, within the range of examiner control, to become a part of the systematic variation contributing to test performance. It is essential that none of the individuals constituting the test sample be placed at a disadvantage by reason of the disabling condition. This type of procedure has been most appropriate to the standardization of certain tests of intelligence upon specific disability groups. Shontz's[14] standardization of the Columbia Mental Maturity Scale and Knox Cubes for measurement of the intellectual potential of hemiplegic patients provides an example of this kind of procedure. On these tests the subjects were not penalized as a result of the hemiplegic condition, and in addition, this evaluation permitted a relatively equitable comparison between right and left hemiplegics who differ on the verbal as well as the physical dimension. There are other instances of progress in this area; however, the large majority of research has been concerned with the development of instruments which are appropriate for the evaluation of various abilities of disabled children.

The second situation includes instances where psychometrics are utilized in investigations designed to evaluate the effects of the disability upon the function under consideration. In this case disability *does* become a part of the systematic variation contributing to test performance. It is not uncommon for investigations of this kind to employ control samples, for comparative purposes, in addition to experimental ones. Other things being equal, the control of variables not pertinent to the particular design, significant differences between experimental (disabled) and control (nondisabled) groups are usually attributed to the influence of the disabling circumstance. It is essential to point out that comparisons have been made exclusively between various disability groups without the utilization of nondisabled controls. The methodological inadequacies of much of this kind of research involving the severely handicapped have already been enumerated by Barker, Wright, Meyerson, and Gonick.[13] However, investigations of this order, by far, have been the most productive of research in rehabilitation.

Summary

The application of tests in the vocational evaluation of the adult physically disabled provides useful data which aids the comprehensive rehabilitation process. A distinction was made between *evaluation for selection* and *evaluation for guidance*. The latter point of view appears to be most feasible from the rehabilitation perspective. Two approaches, compatible with the guidance process, which emphasized the use of psychometrics were discussed. The need for taking measurements over time and the relationship of the use of tests to local conditions were illustrated.

Some trends in testing the disabled were noted. Although the Wechsler Tests still enjoy wide application for evaluating intellectual status, there has been an increasing use of measures which minimize the response demands placed upon the disabled client. The projective tests and their modifications have become the preferred methods of personality assessment, in spite of the frequent use of the Minnesota Multiphasic Personality Inventory. In appraising certain special abilities, performance tests involving manipulative activities appear to be of considerable value.

Finally, some implications for research were pointed out. Two kinds of experimental situations were illustrated in which psychometrics have prominently figured. Although the research is generally lacking in precision, some progress has been made especially in the modification of instruments suitable for the appraisal of adults.

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Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.

An Analysis of Psychomotor Responses of Adult Hemiplegic Patients

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● This paper presents the findings of an experimental technic in vocational appraisal employed in a hospital for chronic diseases. This technic is a psychomotor test designed to evaluate the motor skills of the upper extremities in determining work levels of individuals who have marginal vocational potential. The items in the test are constructed to evaluate the recognized hand functions and may be completed with one unimpaired hand. It also includes items which will evaluate tactile discrimination and eye-hand coordination. The findings are from a population of in-patients with disabilities which include hemiplegia, paraplegia, quadriplegia, multiple sclerosis, amputations, spinal cord injuries, and various other neurologic and orthopedic disabilities. Correlation studies were conducted utilizing measures of manual dexterity and general intelligence.

In some psychologic functions, right and left hemiplegics are undifferentiated;[1, 2] in other areas right hemiplegics are given the better prognosis for successful rehabilitation.[3, 4] The present investigation was conducted to analyze the possibility of differential performance between two groups of patients with hemiplegia and a group without diagnosed organic brain pathology. The comparisons between the groups were made on the basis of a test of psychomotor skills in which verbal facility is not a requisite for success.

Subjects

The sample was composed of 40 hospitalized adult patients with hemiplegia due to cerebral vascular accidents and a control group of 20 hospitalized patients considered to be free of organic brain pathology according to their diagnoses. The control group was working in the hospital sheltered workshop. The experimental group was equally divided between right and left hemiplegics.

The right hemiplegics had a mean age of 58.3 $\pm$ 11.38. In education, this group possessed a mean of 8.95 $\pm$ 3.85 years of schooling. The mean age and education for the left hemiplegics was 56.2 $\pm$ 14.42 and 7.90 $\pm$ 3.27 respectively. The control group was slightly older with a mean age of 62.5 $\pm$ 12.26. Their mean education in years of schooling was 7.00 $\pm$ 2.85. Differences in age and education among the three groups were not found to be statistically significant. Clinical comparison of two examined groups may give the impression that differences exist between them. Statistical examination, however, may prove this to be only a chance occurrence. A third control group which possesses characteristics similar to the original two groups is therefore essential for such statistical evaluation.

Procedure

Each subject was administered the THOMASAT — an individually administered, timed, performance test designed to evaluate the psychomotor skills of the upper extremities.[5] From a breakdown of functions found important in jobs performed by patients in the sheltered workshop, this test was constructed to appraise eye-hand coordination and the ability to grasp, hold, stabilize, and manipulate objects according to size, shape and color. This scale also evaluates tactile discrimination. The particular items appraise the 10 most commonly recognized hand functions[6] and may be completed with one unimpaired hand. Therefore, with the hemiplegic subjects the measurements were taken on the "good hand." There are some duplications in the hand functions used to perform these tasks.

The various subtests and hand functions evaluated include:

Read at the Thirty-seventh Annual Session of the American Congress of Physical Medicine and Rehabilitation, Minneapolis, September 4, 1959.

This study was supported by a special grant from the United States Office of Vocational Rehabilitation.

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Items 1 and 13: Widths and Lengths. Cylindrical grasp, grasp and release using dowels to determine various widths and lengths.

Item 2. Tactile: Tactile discrimination by assessing the quality of grades of sand-paper and textures of cloth.

Items 3, 11, and 17: Colors, Shapes and Designs. Ball grasp and three prehension pinch, grasp and release employing round, rectangular, triangular, and square blocks in sorting for colors, shapes, and in making geometric designs.

Item 4: Pegboard. Two and three prehension pinch accompanied by grasp and release by placing dowels in designated holes.

Item 5: Lifting. Hook formation by curving the fingers to lift a five-pound box by the handle.

Item 6: Tying. Coordinated bilateral arm and hand movements in tying a box with a piece of string.

Item 7: Hammer. Gross cylindrical grasp with flexion and extension or ulnar and radial deviation of the wrist using a hammer to drive nails in a block of wood.

Items 8 and 16: Tracing and Measuring. Finger tips and/or paperweight stabilization in tracing a wooden pig pattern on two sheets of standard bond paper with a pencil. These functions also are employed in the use of a ruler to measure prescribed distances.

Item 9: Screwdriver. Lever grasp with supination and pronation of wrist employing a screwdriver to place and remove screws in a metal plate.

Item 10: Cut-Out. Thumb, middle and forefingers in a coordinated movement using scissors to cut out paper pig patterns.

Item 12: Stapling. Palm or fist strength using a stapler to fasten pre-cut paper pig patterns.

Item 14: Needle. Fingernail pinch and two prehension pinch in picking up a needle, threading it, and sewing two pieces of cloth together.

Item 15: Circles. Two and three prehension pinch involving coordinated movements of the arm and hand in marking and aiming within a series of small circles.

Item 18: Tweezers. Lateral pinch and eye-hand coordination using a pair of tweezers to place small nails in holes of a metal plate.

The items are arranged in order of difficulty and successful performance is in terms of degrees with points awarded for partially correct responses.

Biserial correlations between the subtests and total test scores range from .31 to .80 and indicate that more than one function is being measured by the various subtests. Various validity studies involving the relationships between perceptual-motor behavior, estimated job performance, performance intelligent quotient, verbal intelligent quotient and THOMA-SAT scores were found to be significant beyond the .01 level of confidence ($r = .77, .62, .74$, and $.72$ respectively), thus indicating the influence of cognitive behavior in these manipulative activities. These findings, and generalizations drawn from them, are restricted to the Highland View Hospital population. Consequently, the usefulness of the scale for our population has been established beyond a chance occurrence.

All subjects in the experimental group were referred to the examination by the senior physiatrist. The control group was examined prior to employment in the sheltered workshop. For all groups the testing and scoring were conducted in a standard manner. To determine differences between the groups, chi-square was used to analyze data from each of the subtests based upon a dichotomy of scores that exceeded the median and those that did not. This kind of analysis permits a determination of the significance of discrepancies between the frequency of occurrence of observed responses and those expected to occur on the basis of chance alone.

Results

The results of the chi-square analysis show that each of the various subtests tend not to discriminate one group from another. An inspection of tables 1 and 2 shows that left hemiplegics do not differ from right hemiplegics except on the screwdriver task. With a few exceptions, a similar observation can be seen between the controls and both groups of hemiplegics.

Table 1: Tests Which Do Not Differentiate Experimental and Control Subjects

Subtests	Chi-square Values for Comparisons Between Controls, Right Hemiplegics and Left Hemiplegics
Hammer	.08
Lift	.31
Circles	2.80
Tie	1.60
Widths	1.60
Pegboard	1.00
Staple	3.08
Shapes	1.61
Tactile	1.80
Tweezers	3.00
Colors	2.10
Measure	1.03
Design	2.04

An inspection of the data in table 1 reveals that the groups are quite uniform in their performance; the obtained chi-square values are not significant for any differentiation between the groups. Other examples of the similarity in the groups can be seen in the results from the more complex tasks.

Intellectual demands in measuring various prescribed lines did not prove to be more of a challenge to the hemiplegics than the controls. Similar observations were found on designs in the perception of spatial relations, on shapes where a conceptual shifting of perspectives from color to form discrimination is necessary, and on circles which require fine eye-hand coordination and cognitive behavior. On all of these tasks the differences were very slight. From these findings, the interaction of visual organization and motor action in learning new functions appears to affect those psychomotor skills which show malfunction due to hemiplegia and also those affected by deterioration due to aging.

Of particular interest are four of the five subtests — Needle, Cut-Out, Screwdriver, and Tracing — that differentiate right hemiplegics from the controls, table 2. These tests have experiential features that tend to favor the dominant hand or two hands. This situation is quite pronounced in the differences obtained on the Needle and Cut-Out tasks between controls and left hemiplegics. For the control subjects, these activities are easier since sewing and cutting with scissors are habitually performed with both hands.

One explanation that appears to be plausible for the differentiation between right hemiplegics and controls on the Lengths task is that this hemiplegic group showed a somewhat greater amount of perseveration in conceptual shifting from Widths to Lengths. For example, when required to sort dowels for Lengths, they frequently reverted to the previous frame of reference and sorted for Widths. Consequently, this reduced considerably the quality of their performance on this task. Since all subtests contribute to the total test score, a difference between the hemiplegic groups and controls is expected in view of the hemiplegics' use of only one hand. No significant differences were obtained on the total test performance between right and left hemiplegics.

These findings tend to be substantiated by other investigators. Individuals with left hemiplegia were not differentiated from those with right hemiplegia in the visual and kinesthetic perception of verticality, although there were disturbances in these areas.[1] In simple and choice reaction-time tasks, performance trends between brain injured patients and a matched control group failed to produce significant practice effects with respect

Table 2: Subtests Differentiations for Hemiplegics and Controls

Subtest	Group Comparison and Chi-square Values			
	R-L-C	R-L	R-C	L-C
Lengths	8.40**	1.66	6.40**	3.60
Needle	23.08***	2.00	17.21***	14.54***
Screwdriver	6.66*	4.80*	6.48**	1.60
Cut-Out	17.08***	1.92	20.42***	10.00***
Tracing	7.83**	1.60	6.67***	1.92
Total	11.20***	2.62	6.40**	5.00*

R = Right Hemiplegics; L = Left Hemiplegics; C = Controls. * = .05 level; ** = .02 level; *** = .01 level. These asterisked differences have a small probability of occurring by chance alone. All other values are non-significant.

to mean reaction-time for either group in either task.[1] Right and left hemiplegics have been undifferentiated on nonverbal tests of intelligence.[2] It would therefore seem that, as a group, all hemiplegics are of equal complexity to rehabilitate vocationally. This contention does not provide support for those observers[3, 4] who maintain that patients with dominant hemispheric involvement have a greater probability for vocational success.

Conclusions

A comparative analysis between hemiplegic patients, using only their so-called good hands, and a group of control patients in performance on a psychomotor test, indicated, within the limits investigated, that the groups are relatively undifferentiated. Tasks with experiential qualities that tend to favor the dominant hand or two hands did distinguish right hemiplegics from the controls, and to a lesser degree, left hemiplegics from the controls. The difference in one instance between subjects with dominant hemispheric insult and those without brain damage appeared to be due to the right hemiplegics' greater tendency towards perseveration in a task requiring shifting from the concept of Widths to that of Lengths. All patients were similar in their relative poor performance on tasks requiring abstraction, form discrimination, and the perception of spatial relations.

The differences, while generally nonsignificant statistically, suggest the need for additional inquiry to determine whether psychomotor skills which show impairment due to brain damage and cerebral changes concomitant with aging can be obtained in a larger sample. Our results do not support the contention that patients with dominant hemispheric involvement have a greater probability for successful vocational rehabilitation.

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Great is the art of beginning,
but greater the art is of ending.

— LONGFELLOW

survey of selected literature

This systematic abstracting and indexing of selected journals is made possible by a grant from the American Rehabilitation Foundation, a subsidiary of the Kenny Rehabilitation Institute.

ACTA PHYSIOLOGICA SCANDINAVICA. *Vol. 50 (Part 2) 1960.*

◇ **Intra-Articular Knee Joint Temperature Variations in Response to Cooling and Heating of the Skin in the Cat. Jan Ekholm, and Sten Skoglund. pp. 175-185.**

The intra-articular temperature was measured in the knee joint of the cat during cooling and heating of the anteriomedial aspect of the thigh. Cooling produced a transient increase of the intra-articular temperature before it began to fall, and rewarming gave a transient increased fall of the intra-articular temperature before it began to rise. These paradoxical phenomena could be produced in the intact animals and in animals with partially denervated knee joint. In a flayed limb no paradoxical temperature phenomena could be produced, neither could they be set up in a limb deprived of its sympathetic outflow by unilateral lumbar sympathectomy. The blood pressure was found to increase and decrease transiently during cooling and heating respectively. The variations of the pressure occurred almost simultaneously with the paradoxical temperature phenomena in the joint. These blood pressure variations can, however, only be part of the explanation of the paradoxical effects seen, because cooling the intact limb which increases the blood pressure, was not found to produce the phenomenon in the contralateral sympathectomized side. The mechanisms behind the paradoxical phenomena are discussed and it is concluded that temperature variations as measure of bloodflow variations in response to cooling and heating can only be used when they vary in the opposite direction to the stimuli applied.

◇ **On the Reflex Effects from the Knee Joint of the Cat. J. Ekholm; G. Eklund, and S. Skoglund. pp. 167-174.**

The reflex effects on extensors and flexors of the knee joint have been studied in response to various stimulations of the knee joint capsule and the medial collateral ligament. The joint receptors were activated by increasing the intra-articular pressure or by pinching the anterior aspect of the knee joint capsule. This stimulation caused an inhibition of the knee extensors and a facilitation of the knee flexors in both the decerebrated and decerebrated and spinalized preparation. Activation of the receptors in the medial collateral ligament was likewise found to produce a flexor facilitation in the decerebrated and spinalized animal, effects that sometimes could be produced even in the decerebrated animal.

Alveolo-arterial gas exchange at rest and during work at different O_2 tensions. *Asmussen, E., and M. Nielsen. p. 153.*

AMERICAN JOURNAL OF PHYSIOLOGY. *Vol. 199, Sept. 1960.*

◇ **Adaptation to the Cardiac Necrosis-eliciting Effect of Stress. E. Bajusz, and H. Selye. pp. 453-456.**

This is a study of the adaptation process which produces specific resistance and nonspecific or cross resistance to potentially pathogenic stimuli. Rats were chronically treated with 9 *a*-fluoro-hydrocortisone acetate (F-COL) and sodium acetate to sensitize them to the cardiac necrosis eliciting effect of stress. Rats so treated are susceptible to the development of extensive cardiac infarcts upon sudden exposure to stress. The stressors used in this study were cold bath, muscular exercise, subcutaneous injections of 300 μg of noradrenaline, restraint, and bone fractures of all four extremities. For adaptation one of the first four of these stressors was used in successive daily doses of increasing severity. To elicit cardiac lesions one of the five stressors in severe dose was suddenly applied.

Administration of F-COL + Na-acetate did not produce histologically detectable lesions. Non-adapted rats treated with these drugs did, however, develop large lesions upon sudden exposure to one of the stressors. Gradual adaptation to the given stressor proved very effective in protecting the animal from the lesions so produced in unadapted animals. Furthermore, gradual adaptation to any one of the stressors provided protection against cardiac lesions following the sudden application of any other stressor; i.e. cross adaptation was produced. In general adapted animals also survived longer than unadapted animals upon exposure to severe stress. The authors point out that the results cannot be explained on the basis of adaptation by increased corticoid secretion since the drug treatment induced adrenal atrophy.

◇ **Conduction in Smooth Muscle: Comparative Structural Properties. C. L. Prosser; G. Burnstock, and J. Kahn. pp. 545-552.**

This is the first of two papers reporting exhaustive studies of smooth muscle. Visceral muscles investigated were pig esophagus, guinea-pig taenia coli, cat circular and longitudinal intestinal muscle, rat and guinea-pig ureters, dog retractor penis, rabbit bladder and guinea-pig vas deferens. Cat nictitating membrane, pig external carotid artery, renal vein and pulmonary artery and vein were chosen for the study of smooth muscle in which conduction is via nerves. Both light and electron microscopy were used. An important overall finding was that a high correlation exists between the conduction velocity and the fraction of the total muscle volume occupied by extracellular space. Considerable information is given regarding the detailed microstructure of various muscles. An outstanding feature of the intracellular structure was the many vesicles seen. Large clear vesicles of 1000 — 4000 Å diameter were arranged superficially in the fibers. Many small vesicles of more uniform size (100 — 300 Å diameter) were closely associated with the large types and arranged in either single or double layers beneath the cell membrane. Longitudinal rows of vesicles were observed throughout the fibers. None of the muscles examined exhibited protoplasmic continuity. Individual fibers were always bounded by a distinct membrane. Protuberances of cells formed intimate contact with adjacent cells, however. The authors designate these structures as bridges. The bridges are regarded as possibly serving one or both of two functions; namely, intercellular electrical continuity or mechanical connection and support between cells.

◇ **Conduction in Smooth Muscles: Comparative Electrical Properties. G. Burnstock, and C. L. Prosser. pp. 553-559.**

This paper reports on the depolarization potentials, the conduction velocity of impulses, the action potential parameters, strength-duration data and muscle resistance and capacitance in the same muscles whose structural properties were covered in the previous paper. High conduction velocity is correlated with low resistance in the sucrose gap electrode system, high capacitance, fast spikes, short refractory periods, low chronaxie, and long fibers. Conduction velocities measured ranged from 15 cm/sec for pig esophagus to 4.1 cm/sec for intestinal muscles to 1.6 cm/sec for retractor penis. Conduction of impulses was found to occur only in muscles of less than a minimum cross section and the distances over which conduction took place correlated inversely with stimulus threshold and interfiber distances. The authors conclude that conduction in smooth muscle depends on low resistance paths between parallel fibers and on the excitability of individual cells. Excitability was generally increased by treatment of the preparations with the chemical transmitter substances, adrenaline and acetylcholine.

Action potentials of accessory respiratory muscles in dogs. *Ogawa, T.; N. C. Jefferson; J. E. Toman; T. Chiles; A. Zambetoglou, and H. Necheles. p. 569.*

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AMERICAN JOURNAL OF PHYSIOLOGY. *Vol. 199, Oct. 1960.*

◇ **Role of the Kidney in Erythropoesis. W. Suki, and A. Grollman. pp. 629-632.**

The experiments reported in this paper were performed to establish whether the role of the kidney is vital to erythropoesis. Previous work on this subject had not produced definitive results. Three groups of dogs were studied. In a two-stage operation, one group was bilaterally nephrectomized. A second group was unilaterally nephrectomized, and a ureterovenous anastomosis was established for the remaining kidney. The third group served as controls. Azotemia was minimized in the oliguric animals by peritoneal lavage. After recovery from the operation (three to four days), blood volumes were determined and radioiron was injected into the bloodstream. At intervals thereafter for three days, blood samples were withdrawn for estimation of the rate of iron disappearance from the plasma and for the rate of uptake in the hemoglobin. Blood volumes were estimated at these times. Radioiron uptake and reticulocyte counts were made in two groups of starved rats. One group served as a control while the other group was injected with purified renal extracts. The experiments on the dogs revealed that radioiron disappeared at a much slower rate and that it was incorporated in hemoglobin at a

much slower rate than in either of the other groups of animals. The animals with uterovenous anastomosis responded essentially the same as the control group. The rat experiments demonstrated that the renal extracts were an effective stimulus for erythropoesis. The authors conclude that the kidney produces a humoral factor essential for erythropoesis.

◇ **Afferent Initiation of Shivering. C. M. Blatteis. pp. 697-700.**

The occurrence of experimentally produced shivering in dogs was correlated with various subcutaneous and deep arterial temperatures. The effect of interrupting the peripheral vascular and neural pathways was also investigated. Under pentobarbital anesthesia the left rear leg was amputated at the hip except for bone and the trunk nerves and blood vessels. The severed leg was then cooled by a coil of rubber tubing through which water at 4 C. was circulated. Four experimental procedures were employed using six animals with each procedure. In group 1, after two hours of cooling the sciatic-peroneal and femoral nerves were sectioned. In group 2, after two hours of cooling the femoral artery and vein were occluded. In groups 3 and 4, nerve section or vascular occlusion respectively were carried out one hour before cooling begun. Early vascular occlusion or nerve section did not produce observed differences in the course of shivering. Thirty-seven per cent of the dogs exhibited shivering. Nerve section did not alter the shivering response. During vascular occlusion shivering lessened in severity and then disappeared. Deep temperatures were not affected by occlusion or nerve section. The author concludes that shivering may be a reflex response to the temperatures of perivascular tissues. He did not discuss the possibility of humoral mediation of shivering.

Kinetics of response to epinephrine of isolated rabbit ear. *Stinson, R. H., and A. C. Burton. p. 710.*

AMERICAN JOURNAL OF PHYSIOLOGY. *Vol. 199, Nov. 1960.*

◇ **Control Circulatory Values of Morphine-Pentobarbitalized Dogs. S. Deavers; E. L. Smith, and R. A. Huggins. pp. 797-799.**

The work reported in this paper was carried out to render available the average values of some of the cardinal circulatory parameters in normal dogs subjected to a standard laboratory anesthetic. The following procedure was carried out on 100 mongrel dogs, which were not fasted prior to experiment. All animals were anesthetized with 10 mg/Kg of morphine sulfate subcutaneously followed 20-30 minutes later by intravenous sodium pentobarbital at 15 mg/Kg A cardiac catheter was placed into the jugular vein and passed to the level of the right atrium for blood sampling. The right femoral vein was isolated for use as an injection site. Blood pressure was recorded with a Hamilton manometer. The average results were (the ± figure represents one standard error from the mean) weight — 8.6 ± 0.25 Kg; cell volume — 33.5 ± 0.74 cc/Kg; plasma volume — 50.2 ± 1.11 cc/Kg; venous hematocrit — 45.2 ± 0.73%; circulatory hematocrit — 40.2 ± 0.68%; plasma proteins — 6.25 ± 0.07 g/100 cc; systolic pressure — 139.0 ± 2.53 mm. Hg; diastolic pressure — 65.6 ± 1.46 mm. Hg, and heart rate — 85.9 ± 2.86 beats/min. Comparison of the present results with those available from the literature is given. *N.B. The abstractor believes a mistake in printing occurred in the standard error of the last three parameters listed. He thinks these figures should be 25.3, 14.6, and 28.6 respectively.*

◇ **Flow Rate of Urine as a Determinant of Renal Countercurrent Multiplier System. P. H. Albrecht, and R. L. Malvin. pp. 919-922.**

This paper presents experimental evidence pertinent to the important hypothesis of the countercurrent multiplier system in explaining the ability of the kidney to excrete concentrated urine. The original theory of countercurrent action predicted that the concentration of the urine would be influenced by the rate of blood and urine flow in the medulla of the kidney. Recent work by other authors had produced circumstantial evidence along this line. These experiments were designed to further test this idea. Under anesthesia both ureters of dogs were catheterized, and the left renal artery was catheterized via the aorta for injection of material into the renal bloodstream. Osmotic diuresis was established by mannitol infusion. Urine osmolarity and clearances of creatinine and PAH were determined for each kidney. In the experimental period desired reduction in urine flow was effected by partial clamping of the ureter. This manuever influenced the GFR but not the renal blood flow. During mannitol diuresis, partial occlusion of the ureter (restricting urine flow) resulted in increased urine osmolarity. Maximum osmolarity was obtained by restricting urine flow to about 30 per cent of that in the control kidney. Further reductions in flow resulted in a smaller increase in osmolarity. The authors interpret this last result as indicating that the unaltered peritubular capillary flow was thus enabled to sweep out interstitial sodium reducing the countercurrent

gradient and concomitantly reducing urine osmolarity. Data is also given on the kinetics of medullary sodium washout by transient mannitol diuresis. The paper represents a vigorous experimental study of the countercurrent hypothesis.

Pressure-flow relationships in the coronary vascular bed of the dog. *Scott, J. B.; R. A. Hardin, and F. J. Haddy. p. 765.*

Influence of diet on transamidinase activity in dystrophic mice. *Coleman, D. L., and M. E. Ashworth. p. 927.*

Thermogenic and adaptive mechanisms in hibernation and arousal from hibernation. *Mokrasch, L. C.; H. J. Grady, and S. Grisolia. p. 945.*

Effect of adrenergic blockade with hydergine on hyperglycemia accompanying hypothermia in dogs. *Kilburn, K. H. p. 955.*

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ANNALS OF PHYSICAL MEDICINE. *Vol. 5, Aug. 1960.*

◇ **A Correlated Study of Intensity-Duration Curves and Terminal Neuronal Reinnervation of Muscle. E. N. Coomes. pp. 243-251.**

The paradoxical finding of normal intensity duration curves in chronic lower motor neuron degenerations, for a considerable stage in the disease, is probably due to sprouting of healthy terminal axons with subsequent reinnervation of previously denervated muscle fibers. This increase in the motor unit size of residual nerve fibers masks the denervation and causes normal electrical reactions to persist in weak and wasted muscles. Biopsies taken from muscles in the region of the motor point, in patients with chronic lower motor neuron disease demonstrated branching of terminal axons occurring alongside degeneration of other terminal axons. Intensity duration curves performed on these muscles prior to biopsy were normal.

◇ **A Method for Increasing the Depth Heating Effect of Infrared Radiation. R. Harris, and S. K. Sarkar. pp. 252-257.**

The increase in temperature at various depths below the skin produced by infrared radiation may be increased by blowing air at room temperature across the skin over the heated part. The cooling effect produced by the blower at the skin surface makes it possible for the lamp to be placed about one-third closer to the skin and hence double the dosage delivered. A 1,000 watt radiant heat lamp tolerated at a distance of 18 in. was movable to a distance of 12 in. when a blower directing air across the skin was applied. At a depth of one-half in. below the skin, the temperature elevation rose from 2.8 to 3.6 C. and at one in. depth from 1.3 to 2.1 C.

Circulating antibody production in rheumatoid arthritis. *Greenwood, R., and M. Barr. p. 258.*

Pain in the shoulder. *Mattingly, S. p. 266.*

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ARTHRITIS AND RHEUMATISM. *Vol. 3, Oct. 1960.*

◇ **The Relationship of Human Genital Pleuropneumonia-like Organisms to Arthritis Complicating Urethritis. D. K. Ford. pp. 395-402.**

The etiologic agent in Reiters syndrome remains obscure. Past investigation suggests the cause may be related to the etiology of nongonococcal urethritis. To date, attempts to incriminate a virus or PPLO have been negative. This study utilized a tissue culture method with human amnion cells, hoping to facilitate the growth and isolation of such PPLO organisms as might be present within the inflamed joints of these patients. Culture of 15 synovial exudates from 12 patients with venereally acquired arthritis did not reveal PPLO. Also, 240 patients attending venereal disease clinic were studied and 75 PPLO strains were isolated from urethral discharges. However, there was no evidence to link PPLO etiologically with nongonococcal urethritis or Reiters syndrome.

Vascular lesions in dermatomyositis. *Boylan, R. C. and L. Sokoloff. p. 379.*

Immunization to experimental arthritis in rats. *Hershberger, L. G.; L. M. Hansen, and D. W. Calhoun. p. 387.*

An attempt to produce systemic lupus erythematosus and rheumatoid arthritis by crude desoxyribosenucleic acid and joint antigens. *Dubois, E. L., and Y. J. Katz. p. 403.*

Some carbohydrates of synovial fluid. *Smith, J. E.; G. T. Crowley, Jr., and R. B. Giles, Jr. p. 409.*

Current comment: On the dual etiology of hyperuricemia in primary gout. *Wyngaarden, J. B. p. 414.*

Special announcement: The history of arthritis and rheumatism. *Blumberg, B. S. p. 421.*

President's message: Creativity in arthritis research. *Hartung, E. F. p. 423.*

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BRITISH MEDICAL JOURNAL. *Vol. 2, Nov. 1960.*

◇ **Coronary Artery Disease. H. Florey. pp. 1329-1335.**

In this article the author puts into clear, concise and critical perspective the results of recent research on the pathology, pathogenesis and treatment of coronary artery disease. He examines first two separate but associated components of coronary artery disease: alterations in the wall of the artery itself and alterations in the content of the artery. So far as the arterial wall is concerned, the mechanism of transport of substances in the blood across the continuous cellular barrier of the endothelium is far from clear. The importance of cholesterol in the development of atherosclerotic lesions in man is unsettled. The remarkable pleomorphic lesion of atheroma and their patchy distribution have never been satisfactorily explained. Mechanical stresses associated with the circulation have received critical attention, and the possibility that mechanical damage to the arteries might initiate lesions that ultimately lead to deposition of fibrin and lipid is one to be seriously considered. In considering alterations in the content of the artery, the author stresses the differences between thrombosis and clotting. Thrombosis is initiated by the deposition of platelets on the wall of a vessel in which blood is flowing. These deposits build up, entangle white corpuscles, and entrap red cells. With growth of the thrombosis, fibrin appears, but this is not an initial constituent. Thus, a thrombus is an introvascular object with a characteristic structure, where a clot is formed by fibrin, which entangles the blood constituents in its immediate vicinity. Many attempts have been made to show that the blood of arteriosclerotic patients clots more easily than that of so-called normals, but even if this were so, it would not mean that it would be more apt to deposit a thrombus in a vessel, for this depends on alterations to platelets. There is evidence to suggest that it may be thrombosis rather than arteriosclerosis which is increasing and leading to the present high incidence of coronary heart disease. The author inquires whether the enormous number of observations and experiments already recorded have given us anything firm on which to base prevention and treatment of coronary heart disease. Although certain developments are promising, the honest answer at present is in the negative. No one of the medical or surgical procedures proposed and in use at present is of undisputed and proved value. Faced with a problem of such extreme complexity, like that of coronary heart disease, the author closes with a word of caution against easy and exaggerated enthusiasm and emphasizes the need for well-planned, long-term, objective studies.

◇ **Long-term Followup of Hydrocephalic Infants Treated by Operation. A. R. Taylor; J. R. Milliken, and P. P. Davison. pp. 1356-1359.**

This is a follow-up report on five children surviving out of eight operated on for communicating hydrocephalus in 1952. The cases were all treated by thecoperitoneal anastomosis and the age at time of operation varied from one week to 11 months. The physical, emotional intellectual status is reviewed and found to lie within the normal range. All the survivors have reached school age with I.Q.'s just over 100, showing no obvious personality disorders and apparently being happily integrated into their families. There is still no definite criterion of operability. Thickness of surviving pallium is not a reliable prognostic guide to the intellectual or emotional status of the survivors. Only one of the infants described by the authors had a brain thickness of more than 1 cm.; in two it was about 0.3 cm. Insofar as the present small series gives any guide to surgical treatment, it would suggest that the communicating group should almost always be treated surgically and that the outcome is likely to be favorable if the early complications of operation are avoided.

◇ **The Surgical Treatment of Parkinsonism. F. J. Gillingham; W. S. Watson; A. A. Donaldson, and J. A. L. Naughton. pp. 1395-1402.**

This paper is concerned with the study, over a period of five years, of the effect of stereotoxic electrocoagulation lesions in the globus pallidus, internal capsule and thalamus, separately or in combination, in 60 patients with Parkinsonism. All patients were under 65, except one, a

man of 72, with strictly unilateral disease. The largest group was between the ages of 50 and 60. Patients over 65 should be considered for surgery only when the disease is essentially unilateral and when they are in good physical and mental condition. Without question the best results are achieved in those patients under 60 in whom rigidity predominates and the disease is slowly progressive and only moderately advanced. A detailed description of the technic followed by the authors is presented. In 53 of the 60 patients, or 88 per cent, limb tremor and rigidity were abolished or significantly reduced to give practical benefit. There were no complications in this group. Six patients, despite successful treatment of limb tremor and/or rigidity, showed various types of complications. Only one patient was unchanged. There were no immediate deaths from operation; but one patient died from a ventricular hemorrhage, and another from a staphylococcal pneumonia three months after operation. The best type of lesion for the effective and prolonged relief of tremor and rigidity in the authors' series would seem to be the double one, made at the same time in the ventrolateral nucleus of the thalamus and in the globus pallidus. Other associated symptoms, commonly seen in Parkinsonism were poorly relieved, if at all, by operation. The festinant gait, oculogyric crises, reduction of voice volume, and excessive salivation remain difficult problems. Most patients began to get up and about on the third post-operative day. In every patient active physical therapy was started one week after operation. Attention was particularly paid to posture and walking and to the rehabilitation of the improved limbs. Some patients showed a tendency to neglect the improved limbs temporarily. There were no sensory deficits to account for this. No doubt the disabled limb had been neglected for some time pre-operatively because of uselessness from gross disability, but this could not be accepted as the whole explanation.

◇ **Hypoxia and Thoracic Scoliosis. D. B. Shaw, and J. Read. pp. 1486-1489.**

The present study was undertaken in an attempt to discover mechanisms by which deformity of the chest may predispose to hypoxia. Fourteen patients with severe scoliotic deformity of the spine were studied; these included cases with and without bronchitis. Arterial blood gases were analyzed in nine patients; estimation of vital capacity, one-second forced expiratory volume, evenness of ventilation, and ventilation-perfusion ratios were made in ten, and static lung volumes were measured in seven patients. The arterial oxygen saturation was below the normal range in all cases. The mean was 87.1 per cent, with a range of 83-91 per cent. The mean carbon dioxide tension was 48.6 mm. Hg, and the range was 36-62 mm.; the normal range being 35-45 mm. Hg. These abnormalities could not be the result of alveolar hypoventilation alone. The maximum breathing capacity was below the normal values in all cases. Patients who suffered from bronchitis in addition to scoliosis tended to have a marked increase in airways resistance and some increase in reserve volume. Those without bronchitis had a normal degree of airways resistance and residual volume, but a reduction in total lung capacity. The most striking finding in the present investigation was unevenness of ventilation, or ventilation-perfusion ratio throughout the lung in every case, compared with normal standards. It is suggested that these disturbances in pulmonary function were due to scoliosis and that they predisposed to the development of hypoxia.

◇ **Investigation Into Methods of Collection of Urine for Culture from Men and Women. S. H. C. Clark. pp. 1491-1493.**

It is generally agreed that mid-stream specimens from men are satisfactory for culture, but in women it is said that the only satisfactory specimen is one taken by catheter. The main purpose of this investigation was to see if it were possible to collect a satisfactory mid-stream specimen of urine from women. The collection of specimens of urine from men is also considered for comparison. The results showed that 72 per cent of the mid-stream urine collected from women was satisfactory (no growth or only scanty growth) and this finding compares very favorably with the results from men in which 74 per cent of the mid-stream urine was satisfactory. The investigation also demonstrated the importance of culturing the urine as soon as possible, and certainly not later than the same day. This is especially important in mid-stream urine from women as there is a striking difference between the percentage of satisfactory specimens cultured the same day and those cultured the next day — 80 per cent as compared with 33 per cent. A plea is made for the abandonment of routine catheterization to obtain specimens of urine for culture from women. Satisfactory mid-stream urine can be obtained without too much trouble and without danger of introducing infection.

Coronary artery aneurysm. *Forbes, G., and A. Bradley. p. 1344.*

Lactic dehydrogenase activity in acute myocardial infarction. *King, J., and A. Waind. p. 1361.*

Psychogenic urinary retention after parturition, resulting in hydronephrosis. *Knox, S. J. p. 1422.*

Menstruation and accidents. *Dalton, K. p. 1425.*

Some dermatologic hazards of today. *Bettley, R. F. p. 1467.*

Oliguric renal failure of surgical origin. *Schackman, R.; M. D. Milne, and N. W. Struthers. p. 1473.*

Subacute combined degeneration of the cord after partial gastrectomy. *Knox, J. D. E., and I. W. Delamore. p. 1494.*

BRITISH MEDICAL JOURNAL. *Vol. 2, Dec. 1960.*

◇ **Etiology, Diagnosis and Treatment of Paraesthesiae in the Hands. D. Kendall. pp. 1633-1640.**

The clinical features, etiology, diagnosis and treatment of the carpal tunnel syndrome are reviewed by the author in relation to 327 patients under his care in the years 1948-58. The majority of patients were women; only 20 men (6%) were seen with this ailment. The condition has been all too commonly misdiagnosed in the past and much time and effort have been directed toward treatment of the neck and shoulder in the mistaken belief that the symptoms were related to "cervical rib," "costo-clavicular compression," or "cervical osteoarthritis." Among the cardinal symptoms of the carpal tunnel syndrome, paraesthesiae, predominantly nocturnal, were by far the most common and were the presenting symptoms in 313 (95.7%) of the patients. Paraesthesiae were predominantly unilateral in 225 (72%), the dominant hand being affected in the great majority. Although the burning quality of the pricking sensation was often poorly localized, this was predominantly described in the radial half of the hand, affecting particularly the middle finger, the index finger, and the thumb; the middle finger being the one most constantly affected. A misleading feature of the sensory symptoms is the frequency with which complaint is made of pain in the arm, often extending to the elbow and sometimes even to the shoulder, in association with nocturnal paraesthesiae. Weakness and wasting of the short abductor and opponens pollicis were found to be related to the length of history, and neither was observed in any patient with a history of less than four months. All those with marked motor signs (21% of the whole series) had histories extending over a year or more. The physical signs present may be sensory, motor, or trophic, singly or in combination. Sensory signs were by far the most common and were present in 281 (86%) of the present series. The intensity of the sensory impairment varied within very wide limits, and, when present, was always confined to superficial sensation only, and for the most part to perception of pain only. The disability from wasting and weakness of the thenar muscles is remarkably slight; the greater part of the disability arises from disordered sensation, especially numbness, frequently affecting the tips of the fingers. The disorder is basically considered an ischemic one, in which overuse of the wrist and hand plays an essential part, but the exact mechanism by which this comes about is not entirely clear. Two lines of treatment were adopted depending mainly on the physical signs present: conservative treatment, by means of which the affected wrist was immobilized in Plaster of Paris; and operative treatment, in the course of which the flexor retinaculum was divided. The results were entirely satisfactory. Complete immobility of the wrist brought about such rapid and complete relief of symptoms, it is suggested that application of plaster could be used as a very reliable diagnostic test in cases of doubt.

◇ **Future place of Lumbar Sympathectomy in Obliterative Vascular Disease of Lower Limbs. J. A. Gillespie. pp. 1640-1642.**

The author reviews the clinical progress of 100 consecutive patients who had undergone sympathectomy one to seven years previously for obliterative vascular disease of the legs. In assessing the results the patients were divided into two major groups, those with uncomplicated intermittent claudication and those with cutaneous ischemia. Of 47 patients in the first group, only six, or 13 per cent, obtained positive improvement after sympathectomy. How far this can be ascribed directly to the operation is discussed, considering the fact that intermittent claudication is prone in its natural history to wide spontaneous fluctuations in severity. Patients with ischemic skin changes seemed to benefit most by sympathectomy. In 55 per cent of these patients the skin lesion healed after sympathectomy, and major amputation has not so far been required. Selection of patients is the most important factor influencing the limb recovery rate. Patients who are present with a rapidly deteriorating foot, with a very short history, will probably progress to gangrene and amputation in spite of operation. On the other hand, those patients who develop a minimal skin lesion, such as a pressure ulcer or a small area of digital gangrene in association with long standing claudication, are likely to respond well. This and other reviews have revealed a strikingly high incidence of coronary and cerebral artery disease in patients presenting the symptoms of peripheral obliterative vascular disease. Twenty-five of the 100 patients in the present series were dead when this review was written and 64 per cent

of the deaths were due to a coronary or cerebral vascular accident. The prime indication for lumbar sympathectomy seemed, therefore, to be the early ischemic foot in a patient who has had a long history of vascular trouble.

Schoolgirls' behavior and menstruation. *Dalton, K. p. 1647.*

GERIATRICS. *Vol. 15, Nov. 1960.*

◇ **The Aging Hand. A. E. Flatt. pp. 733-745.**

The processes of aging may produce various changes in the anatomic constituents of the hand with resultant deformities. The treatments for such deformities are presented, including more detailed discussion of carpal-tunnel syndrome, Dupuytren's contracture, shoulder-hand syndrome, and various forms of arthritis. Although splinting and hydrocortisone injections may provide temporary relief, definitive, lasting treatment of carpal-tunnel syndrome consists of surgical section of the transverse carpal ligament thus releasing pressure on the median nerve. Similarly, Dupuytren's contracture is best treated surgically by total excision of the palmar fascia. Patients with shoulder-hand syndrome will generally improve on a program of graduated exercises. Several surgical procedures are described in the treatment of the various deformities of arthritides of the hand. Physical therapy is often useful in alleviating pain and improving function in the hand. Heat, massage, and exercise are briefly discussed, the latter proving most efficacious when prescribed as an active exercise program providing some motivation as in occupational therapy activities. Problems of crutch walking are presented along with a recommendation for more satisfactory hand grips on crutches.

◇ **Measuring Disability in Patients with Hemiplegia. M. Peszczynski, and J. H. Bruell. pp. 750-757.**

In the past in neurologic examination of hemiplegic patients, emphasis has been on factors important in establishing a diagnosis. With current interest on early treatment and subsequent rehabilitation of stroke patients, the need for objective testing and grading of disabilities and remaining abilities has become increasingly important. Various methods of measuring and evaluating the sensory, motor, and psychologic areas of hemiplegics are discussed — methods of testing which are becoming increasingly objective and measurable thus permitting better comparison and interpretation of data.

Oral cholecystography in the aged. *Zboralske, F. F., and J. R. Amberg. p. 746.*

Medical roles in institutions for the aged. *Harris, R. p. 758.*

A new antiapathy agent for geriatric patients. *Chesrow, E. J.; S. E. Kaplitz; J. P. Musci, and R. W. Sabatini. p. 767.*

Tissue immunity and aging. *Kahn, R. L.; S. H. Kim, and A. C. Curtis. p. 773.*

Effects of blindfolding on persons during psychologic testing. *Azima, F. C., and V. A. Kral. p. 780.*

Preretirement education. *Hunter, W. W. p. 793.*

Training in social gerontology. *Donahue, W. p. 801.*

GERIATRICS. *Vol. 15, Dec. 1960.*

Intestinal obstruction in the aged. *Flake, T. M., and C. G. Johnston. p. 817.*

Liver function studies in the aged. *Cohen, T.; L. Gitman, and E. Lipschutz. p. 824.*

The treatment of certain fractures in old people. *Thomson, J. E. M., and R. D. Fusfeld. p. 837.*

Oral pentylenetetrazol in geriatric practice. *Tennent, J. J. p. 848.*

Clinicopathologic conference — a case of polyarteritis with first manifestation in the gallbladder. *Goldner, M. G.; edited by B. Wainfeld. p. 852.*

Geriatric services from the practitioner's viewpoint. *Reynolds, T. E. p. 858.*

Short cut to arachova (Editorial). *Leake, C. D. p. 862.*

Index to volume 15. *p. 863.*

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JOURNAL OF APPLIED PHYSIOLOGY. *Vol. 15, Sept. 1960.*

◇ **External Work in Level and Grade Walking on a Motor-driven Treadmill. J. W. Snellen. pp. 759-763.**

Heat exchange in working subjects was studied during grade walking and level walking in three normal young men. The aim was to determine whether external work in grade walking equals the product of body weight and gained height and whether any energy is converted into heat outside the body in level walking. The subject walked uphill on a motor driven treadmill in a climatic room for three hours and on the level for another hour. Metabolism was kept equal in both situations. Air and wall temperatures were adjusted to the observed weighted skin temperature in order to avoid any heat exchange by radiation and convection. Heat loss by evaporation was derived from the weight loss of the subject. All measurements were carried out in a state of thermal equilibrium. In level walking the heat production by metabolism equalled the heat loss by evaporation. In grade walking the heat production by metabolism was greater than the heat loss by metabolism. The difference between heat production by metabolism and heat loss by evaporation equalled the caloric equivalent of the product of body weight and gained height. The author concluded that in level walking all the energy is converted into heat inside the body. Also, in heat balance studies of working subjects the external work must be subtracted from the total energy expenditure.

◇ **Maximal Work Production in Man. J. G. Fletcher. pp. 764-768.**

When man performs hard physical work, he either works at a constant rate or he works in bouts with rest pauses in between. In both situations he attempts to work at a level which avoids the unpleasant symptoms of fatigue and exhaustion. If, however he is motivated to work at a higher rate, he soon is able to tolerate the increased work output without fatigue. This study investigates quantitatively the gain in endurance of men stepping up and down a bench at a constant rate. The subjects were 12 men of varying degrees of physical condition. They stepped up and down a 22-inch bench 30 times each minute until exhausted. By this procedure a 150 lb. man performs work at the rate of 0.25 h.p. When first tested, the nonathletes were not able to step as long as athletes, inactive subjects as long as active ones, or athletes out of training as long as those in full training. Seven subjects exercised repeatedly. In five of them the improvement exceeded by 500 per cent. All subjects found their endurance increased by 100 per cent or more.

Effect of environmental temperature on work and resting metabolism. *Malhotra, M. S.; S. S. Ramaswamy, and S. N. Ray. p. 769.*

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JOURNAL OF BONE AND JOINT SURGERY. *Vol. 42-A, Oct. 1960.*

◇ **Motor-Unit Action-Potential Counts. Their Significance in Isometric and Isotonic Contractions. J. R. Close; E. D. Nickel, and F. N. Todd. pp. 1207-1222.**

Muscle action-potential counts may be recorded by electronic counters. Total counts for a given interval of time or continuous counts make possible a numerical representation of action potentials produced by the volume of muscle between the longitudinally placed recording electrodes. The integrated curve of total electrical activity may thus be replaced by the action-potential count for determining the actual level of muscular activity. Studies on young, active individuals comparing tension of the soleus muscle measured by a force gauge attached to a skeletal-pin through the calcaneus at the tendinous insertion and the integrated curve and total action potential counts revealed that total counts for ten-second periods of activity increase linearly with the strength of the isometric contraction; continuous action potential count is related directly to tension during isometric or isotonic contractions as long as the muscle is loaded; action potential counts are lower as the muscle is placed at greater lengths where it develops greater tension; the counter, unlike the integrator does not have a time delay between development of electrical activity and development of tension — the count-rate curve actually precedes the tension curve which is to be physiologically expected. The electronic counter appears to have great possibilities in studying the electrical activity in normal muscle as well as in studying the electrical activity of muscles in neuromuscular disorders.

◇ **Hip Shelves in Children. D. M. Bosworth; J. W. Fielding; W. A. Liebler; T. Ishizuka; H. Ikeuchi, and P. Cohen. pp. 1223-1238.**

Skeletal weight bearing in selected children with unstable hips is obtained by constructing a shelf of bone over the acetabulum at the attachment of the capsule of the hip joint. Hip disabilities amenable to the shelf operation are dislocation, subluxation and aplasia of the acetabulum. The operation is contraindicated in a child with a spastic paralysis or in children with insufficient hip girdle strength to control the hips. Follow-up studies show that in some patients absorption of the shelf may cause decrease in length, thickness and width of the shelf. At times the apparent decrease in size is due to an increase in the size of the pelvis and femoral head while the shelf remains the same length. Some shelves may grow thicker accompanied by some loss in length. Other shelves develop a narrow cavity. Non-union is occasionally a problem and some of the shelves may fracture; however, the fracture practically always unites without gross displacement. A total of 60 children ranging in age from 1 to 14 years had 82 shelves inserted. No redislocations occurred except in three children with hip instability due to cerebral palsy and in two patients with myelomeningocele with the resultant spastic weakness. No adverse effects of the shelf on hip function were observed. None of the patients had significant loss of motion because of bone block or adhesions, increased muscle weakness or increase in instability. The period of followup ranged from two to 20 years with an average of 6.3 years.

Into-talus transposition of tendons for correction of paralytic valgus foot after poliomyelitis in children. *Axer, A. p. 1119.*

Dislocation of the hip secondary to trochanteric decubitus. A complication of multiple sclerosis. *Schneider, M., and A. J. Krug. p. 1165.*

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JOURNAL OF EXPERIMENTAL NEUROLOGY. *Vol. 2, Dec. 1960.*

◇ **Electrophysiological Studies of Peripheral Nerve Regeneration with Special Reference to the Small Diameter (Gamma) Fibers. C. A. Thulin. pp. 598-612.**

Evidence is presented that separate mechanisms of muscle action, subserved by nerve fibers of different calibers, require different periods of time for reconstruction following denervation. The present investigation deals with the events of regeneration of the specific functional components of a skeletal muscle nerve and the influence of Milliporetubulation on re-establishment of nerve function. A one cm. segment of the posterior tibial nerve was removed in 42 adult cats. The terminal one cm. of each of the nerve stumps of thirty animals was drawn into a Millipore tube. In the remaining twelve animals no tube was used. The first sign of re-establishment of neuromuscular junction was observed six weeks after surgery in the Millipore shielded series, and somewhat later (eight weeks) in the nontubulated nerves. Establishment of connections between the large afferent fibers and muscle spindles and tendon organs of Golgi was demonstrated about the same time. Thus, no appreciable difference was found to exist between the times required by the afferent and large efferent fibers to traverse a distance of one cm. across a nerve gap and to proceed down into the muscle to re-establish functional connections. The function of the small efferent (gamma) fibers was restituted considerably later in both series (15th and 26th week respectively). The delay observed in the nontabulated nerves indicates that the Millipore favorably affected outgrowth of the small nerve fibers. Full use of the gastrocnemius and soleus muscles was not restored immediately following the re-establishment of the neuromuscular connections of the large axons. Proper coordination of muscle movements started to be seen not before 15 weeks after surgery. This finding strongly indicated a direct relationship between restoration of the efferent gamma fibers' innervation and the ability to coordinate normally muscle movements.

◇ **Fractionation of Motor Units by Curare. S. Locke, and E. Henneman. pp. 638-651.**

The authors have investigated the effect of curare upon the population of muscle fibers innervated by a single motor neuron. Experiments were carried out on 33 adult male rats and the technic to record the potentials of a single motor unit is described. Two patterns of response to curare were noted. In one type the amplitude of responses remained at the control level until it abruptly dropped to zero or a very low level. The second pattern of response consisted of an initial gradual decline, with one or more abrupt downward steps and a large terminal step. During recovery from curare a similar pattern in reverse order was sometimes observed. Analysis of these effects with a fast sweep showed that units which declined gradually in amplitude with "steps" were found to be made up of two or more components, each of which

responded in an all-or-none fashion. As the effect of curare developed, these components became distinguishable as separate entities because of unequal delays at their neuromuscular junction. The original synchronized responses of individual components, that is, began to fall more and more out of phase which produced the gradual decline in amplitude. "Steps" occurred whenever a component failed to respond. Though there is no anatomical or physiological evidence to suggest that groups of fibers function together as sub-units, the authors' findings would suggest that some component of the motor unit do function as an entity.

Copper content of brain tissues in health and in certain nervous diseases. *Grashchenkov, N. I., and B. M. Heckht. p. 573.*

Role of the sympathetic and parasympathetic systems in the consensual pupillary darkness reflex. *Guth, L., and C. J. Bailey. p. 623*

Axoplasmic flow rates during nerve regeneration. *Ochs, S.; R. Kachmann, and W. E. DeMyer. p. 627.*

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JOURNAL OF PHYSIOLOGY. *Vol. 151, May 1960.*

◇ **The Effect of Sympathetic Stimulation on Mammalian Muscle Spindles. C. C. Hunt. pp. 332-341.**

Stimulation of the sympathetic fibers that terminate in muscle spindles of cat muscle produces an initial lowering of spindle receptor threshold followed by a later rise in threshold. Sympathetic stimulation at rates of at least 2-5/sec and durations of up to about 40 seconds are needed to produce threshold changes. The magnitude and duration of the changes depends on the frequency and duration of the sympathetic stimulation. Threshold changes can be observed, in response to stretch, in the frequency of discharge of spindle afferent fibers and in the spindle response to fusimotor stimulation. Intravenous injection of adrenaline produces similar effects. Tendon organ discharge is unaffected by sympathetic trunk stimulation. The release of a substance at sympathetic nerve endings within the spindle is postulated. At appropriate concentrations receptor threshold drops and at higher concentrations threshold rises. The functional significance of this sympathetic fiber influence on spindle activity is not known.

◇ **The Contribution of the Intercostal Muscles to the Effort of Respiration in Man. A. Taylor. pp. 390-401.**

Electromyographic examination of the intercostal muscles with short range bipolar needle electrodes can distinguish the activity of the various layers during respiration. During vigorous respiratory efforts the external intercostal muscle is inspiratory in action and the internal intercostals expiratory with the exception of the parasternal part of the internal intercostals which are inspiratory. The sternocostal portion of the transversus thoracic muscle contributes to expiratory efforts. In quiet relaxed breathing, activity is restricted to the parasternal portion of the internal intercostals during inspiration, and in the lower lateral part of the internal intercostals during expiration. The external intercostals are inactive during quiet respiration.

Central control of sympathetic cardioacceleration in the cat. *Peiss, C. N. p. 225.*

Dynamics of accommodation responses of the human eye. *Campbell, F. W., and G. Westheimer. p. 285.*

The stimulation of respiration by 5-hydroxytryptamine in man. *Parks, V. J.; A. G. Sandison; S. L. Skinner, and R. F. Whelan. p. 342.*

Is muscle contraction initiated by internal current flow? *Sten-Knudsen, O. p. 363.*

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JOURNAL OF PHYSIOLOGY. *Vol. 152, June 1960.*

◇ **Cardiovascular and Respiratory Responses to Heating the Carotid Blood. P. P. Newman, and J. H. Wolstencroft. pp. 87-92.**

A drop in blood pressure of 40-70 mm. Hg occurs in anesthetized cats when carotid blood is heated until brain temperatures reach 41-42C. Respiratory rate increases simultaneously and heart rate is unchanged or slightly reduced. The fall in blood pressure occurs in decerebrate animals with the hypothalmus removed, but is not seen in spinal animals. Bilateral section of carotid sinus nerves does not affect the response. The heated blood appears to produce its effects by acting on the medulla.

◇ **A Heat-Sensitive Region in the Medulla. R. L. Holmes; P. P. Newman, and J. H. Wolstencroft. pp. 93-98.**

Selective heating of certain regions of the medulla and pons with a small heating electrode increases respiration and produces a fall in blood pressure of 40-60 mm. Hg in anesthetized cats. These reversible effects develop when temperature elevations to 41-42C. are produced. Maximal response is found in the upper and medial reticular formation of the medulla at the level of the trapezoid body. Histological examination identifies this region as the nucleus reticularis gigantocellularis.

The mechanical properties of relaxing muscle. *Jewell, B. R., and D. R. Wilkie. p. 30.*

The latency and form in man of the occipital potentials evoked by bright flashes. *Cobb, W. A., and G. D. Dawson. p. 108.*

Nitrogen elimination from the tissues during oxygen breathing and its relationship to the fat: Muscle ratio and the localization of bends. *Lundin, G. p. 167.*

The influence of histamine inhalation on the pulmonary diffusing capacity in man. *Bouhuys, A.; J. George; R. Jonsson; G. Lundin, and S. E. Lindell. p. 176.*

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NEW ENGLAND JOURNAL OF MEDICINE. *Vol. 263, Nov. 10, 1960.*

◇ **Physical Activity and Human Obesity. Anna-Marie Chirico, and Albert J. Stunkard. pp. 935-940.**

This report deals with the physical activity and attitudes toward such physical activity of obese and nonobese persons. Twenty-five obese men were matched for age, occupation and socio-economic background with 25 nonobese men, and 15 obese women were matched in similar fashion with 15 nonobese women. Physical activity was measured by means of pedometers. It was found that the obese women were far less active than their nonobese control subjects. The mean activity of the obese women was 2.0 miles per day, as compared with 4.9 miles per day for the nonobese women. Comparison of obese and nonobese men showed less difference in physical activity. The mean activity of the obese men was 3.7 miles per day, and that of the nonobese men 6.0 miles per day. Rank order analysis revealed that the difference between obese and nonobese subjects was considerably greater among women than men. These differences in physical activity were paralleled by differences in attitudes toward activity. Obese women indicated that they were more passive than nonobese women in situations of despondency, boredom and social interaction. Obese men, on the other hand, did not differ from nonobese men in their reported responses to such situations. Decreased physical activity may play a part in the obesity of women, but it appears to be less important in that of men.

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NEW ENGLAND JOURNAL OF MEDICINE. *Vol. 263, Nov. 24, 1960.*

◇ **Demonstration of L. E. Cells at Local Inflammatory Sites in Patients with Systemic Lupus Erythematosus. P. E. Perillie; P. Calabresi, and S. C. Finch. pp. 1052-1055.**

The present study consisted of the serial application of cover slips to the abraded skin surfaces of patients with systemic lupus erythematosus to observe the development of L.E. cells in situ. The effects of systemic corticosteroid administration on the development of L.E. cells in the abraded skin area were also evaluated. Eleven patients with systemic lupus erythematosus were studied. The diagnosis was based on clinical findings and confirmed in the laboratory by positive in vitro L.E. cell preparations, fluorescent antiglobulin and L.E. globulin determinations. Local sites of inflammation were produced by superficial abrasion of the papillary layer of the dermis in small areas of skin on the volar surface of the forearm. Sterile, chemically clean cover slips were applied to the lesions. Cells accumulating at these local areas of inflammation affixed themselves to the undersurface of the cover slips. Cover slips were changed at hourly intervals for the first twelve hours and again at twenty-four hours. They were air dried, stained with Wright-Giemsa technic and examined microscopically. Typical L.E. cells were found in the stained cover slips taken from the skin lesions of five of the 11 patients studied. No L.E. cells were found on cover slips taken from any of the control subjects. All five patients with positive L.E. cell cover slip preparations had clinically active disease and positive in vitro L.E. cell preparations and had not received corticosteroid therapy. All six patients with the disease and negative cover-slip tests had received corticosteroids for at least two weeks before examination. L.E. cells when found on the cover slips taken from these patients were demon-

strated between two and seven hours after application of the initial cover slip. A possible role of the L.E. cell factor in the pathophysiology of systemic lupus erythematosus is discussed. The cover-slip method for producing L.E. cells is probably as sensitive as most in vitro L.E. cell tests now used.

Effect of tracheostomy tubes on the resistance to breathing and pulmonary resistance in patients with poliomyelitis. *Ferris, B. G. Jr., and D. Pollard. p. 1048.*

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The Survey of Selected Literature for March 1961 was prepared by

Else A. Tophoj, M.D.	*for*	Acta Physiologica Scandinavica
Odense, Denmark		New England Journal of Medicine
Richard W. Stow, Ph.D.	*for*	American Journal of Physiology
Tehran, Iran		
Walter C. Stolov, M.D.	*for*	Annals of Physical Medicine
Seattle		Journal of Physiology
Robert M. Wells, M.D.	*for*	Arthritis and Rheumatism
Columbus, Ohio		Geriatrics
Osvaldo Miglietta, M.D.	*for*	British Medical Journal
Astoria, N. Y.		Journal of Experimental Neurology
Herbert A. Schoening, M.D.	*for*	Journal of Applied Physiology
Minneapolis		Journal of Bone and Joint Surgery

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book reviews

RESEARCH CONFERENCE ON THERAPEUTIC COMMUNITY. Edited by *Herman C. B. Denber,* M.D. Cloth. Price, $11.00. Pp. 265. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1960.

A series of 15 papers with 20 discussions, from the "Research Conference on Therapeutic Community", Manhattan State Hospital, Wards Island, New York, May 13, 14, 15, 1959 is presented. This was the second meeting of the group whose first discussions are chronicled in "The Dynamics of Psychiatric Drug Therapy". There were 45 participants.

A historical review of the therapeutic community in mental hospitals, in its modern form, is about 150 years old. The history was reviewed in the first paper, and referred to with additional references made from time to time. During these years, programs of "liberalization, humanization, education of the public, therapeutic hope for the patient and restoration of his human rights, and equality with other citizens" were repeatedly set up in Europe and America. They were in general, subsequently engulfed by new periods of "overcrowding, understaffing, underfinancing and their corollaries, dirt, brutality and the traditional madhouse atmosphere."

Now, and since World War II particularly, there is an increasing awareness once more, of what constitutes a therapeutic community and its possible value. The majority of papers describe an individual therapeutic community and the program, structure and apparent value of each. The term "open door" is a general term relating to all, but with various connotations. Programs in Federal, State, Community, and Private Institutions are described in various chapters. In addition, a day hospital, a night center, and a hospital unit for adolescent girls are described.

The Night Center, designed to furnish psychiatric help to those individuals who "for financial or other reasons cannot afford to take time off for partial day time, or total hospitalization", is perhaps the most unique (at least to persons who are not associated with, or studying psychiatric programs). It offers "early treatment to the non-psychotic psychiatric disorders."

Each patient receives individual psychotherapy. Modified insulin, sub-shock and electroconvulsive therapies are given. Those receiving the electrotherapy can leave by 9 p.m., as do the others receiving only psychotherapy. There is a trained professional staff who hold weekly staff conferences.

It is quickly apparent from these various descriptions, that there is no therapeutic community, but "therapeutic communi*ties.*" In a summary of the discussion, it is pointed out that no exact definition of this concept was attempted, but that emphasis was laid on parameters, goals and limitations. Basically, a community is motivated by a belief in social therapy and the concept that treatment of a mentally ill patient should include treatment of his social milieu.

One discussion defined a therapeutic community as "a place that provides a corrective social climate in which the patient can re-live and purge irrational fears surrounding previous relationships and can attempt more constructive and healthier social relationships." Other discussions were less specific, but caution and occasional warnings were expressed to point out that this was not the cure for all mental disease. The physician still has to treat the patient who has a disease, although the community concept, which in addition to the physician's, in a coordinated staff program also includes the nurses, clinical psychologists, social workers, the occupational therapists, recreation director and a vocational counselor.

There is one chapter on "The Use of Drugs to Modify the Social Behavior of Animals," which includes some specific research data on animals in pairs and groups. This points out that the response to drugs is but part of a complex reaction of "drugs — environment — personality — interaction." Since many behavior reactions of humans are similar to those of animals, this is a basis for research among therapeutic groups.

An interesting study is reported in one chapter on "Staff Attitudes, Decision Making and the Use of Drug Therapy in the Mental Hospital." The various staff groups, as groups, though with individual variants, were found to have significantly different attitudes toward drug treatment. As a generalization, the reaction frequently related to the amount of time each group had to spend with the individual patients. Variants among individuals were more marked among the psychiatrists. The "Stanton-Schwartz Phenomena" (the convert reaction of a patient to certain staff members) is referred to as part of the corollary to this study.

There are papers on the relationship of the patient, the family and the practicing psychiatrist; on the discharge of chronic schizophrenic patients; on work and family adjustments of mental patients upon their return to the community. The latter includes a work therapy program as necessary hospital treatment before discharge can usually be feasible. Since the purpose of treatment is to return a patient to his home and become useful, even economically, whenever possible, it is pointed out that a group therapy program in a hospital, no matter how thoroughly developed, will break down if proper home and community relationship are not established.

The papers and discussions are interesting. There are numerous references and 18 pages of index. The programs are ambitious. If they can, not only be made to work, but it is possible to continue them, then it would appear they are a hopeful adjunct to the other forms of individual therapy still needed for an individual with a mental disease. A therapeutic community cannot completely replace other treatments.

Furthermore, it was pointed out that group therapy was not inaugurated by psychiatrists in order to reach and treat as many patients as possible, but because group work per se, is an important therapeutic tool. This was pointed out as early as 1905 by Dr. Joseph H. Pratt, who was the first to conduct medical group therapy for tubercular patients at Tufts College Medical School. *(Nila Kirkpatrick Covalt, M.D.)*

MEDICAL FEE GUIDE. A Service of the Medical Reference Bureau. Leatherette looseleaf binder. Price, $20.00, Pp. 563. Medical Reference Bureau, P. O. Box 1405, Stanford, Calif., 1959.

The purpose of this book is to present, in a comparative manner, a picture of the medical fee structure representative of all parts of the continent. It is purely an informative reference work.

A tremendous amount of research was necessary to produce this work. Approximately 100,000 separate fees are listed. No similar compilation of fees has ever been made.

Fees are listed and explanations are given for Workmen's Compensation, Medicare and relative value scales as they are set in each state in which they are offered. Fees paid by a few states for indigent care are also shown. These are usually paid by counties rather than states. A few pages are devoted to fees paid to practitioners of other methods of healing (osteopathic, chiropractic and naturopathic). Blue Shield and private practice fees are also listed.

The chapters are divided into the various surgical and medical services and subdivided into the various organ systems (i.e., integumentary, musculoskeletal, respiratory, etc.). The information is then tabulated by procedure, schedule (i.e., Blue Shield, Workmen's Compensation, etc.), and state. This makes for ease in finding the exact information one seeks.

Nowhere can fees for physiatrists be found. Fees for occupational and physical therapy as allowed by Workmen's Compensation, Medicare, and indigent schedules are listed. The information appears to be accurate and reliable. Considering the thousands of entries, it would indeed be surprising if there were not some errors but I could not find any except for the one of omission as already indicated.

It is especially appropriate that such a book be prepared with loose leaves. The purpose is to keep it up to date and, I would assume, to provide additional information as it comes in.

This book should be of interest to physicians, administrators of medical centers, and hospital accountants who are concerned with the problems of fee schedules. It contains an enormous amount of data. *(Arthur A. Rodriquez, M.D.)*

CEREBRAL PALSY AND RELATED DISORDERS — A DEVELOPMENT APPROACH TO DYSFUNCTION. By *Eric Denhoff*, M.D., and *Isabel P. Robinault*, Ph.D. Cloth. Price, $12.00. Pp. 421, with illustrations. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, 1960.

It is a pleasure to peruse a book upon what has become a very popular subject and find a fresh, practical and over-all approach to the subject. This book should be in the library of every individual and every center where patients with cerebral palsy are under care. It should be used as a text and reference in medical schools and in any school training medical ancillary personnel. Dr. Denhoff is Medical Director, Meeting Street School Children's Rehabilitation Center, Providence, Rhode Island. Dr. Robinault is Director, Professional Education, Institute for the Crippled and Disabled, New York City.

In defining the nature and concept of cerebral palsy the authors have classified the individual syndromes of cerebral palsy, mental deficiency, epilepsy, the hyperkinetic-behavior disorder and the sensory disabilities, under the general head "Syndromes of Cerebral Dysfunction" in order to help unify thinking about cerebral palsy and the related disorders. Since neurological localization and its effects upon other parts of the brain and personality are so difficult or impossible to define, functional capacity or abilities is a better means of classifying the problem. The degree of brain injury and the behavioral function of the child may bear no relationship. The consequences of cerebral injury are subject to individual variation. Many factors influence the physical and psychological picture which the patients present, such as heredity, environment, prenatal and congenital defects, perinatal period

and pregnancy wastage and salvage. The various types of cerebral palsy are defined and methods of examination are described. Particular emphasis, aside from the physical and psychological examinations, is placed upon perceptual-motor dysfunctions. Neurological impairment may be confined to sensory or perceptual areas alone, or a disturbance of these may markedly influence the rehabilitation of the child with more obvious dysfunction. The developmental approach to the treatment of cerebral palsy pivots around abilities rather than disabilities, which means that spasticity or athetosis must not be emphasized out of proportion to the child's total capabilities. The developmental stages in cerebral palsy are not dependent upon chronological age, but are much more closely correlated with mental age and emotional stability. The child's ability to progress from one stage to another depends on his total makeup (physical, intellectual and emotional) and social opportunities, rather than on the neuromotor handicap itself. The many schools of thought regarding neuromuscular education are reviewed and evaluated. The changing psychological approach from one in which certain personality characteristics were recognized as typical of all spastics or athetoids, to a period of individual psychological appraisal of the child which recognizes his uniqueness and his distinctive position in a given family and sociocultural setting, is discussed. The authors consider that a treatment center is important in order to obtain a "team" approach. It makes possible a host of interrelated activities, all stemming from the central concept that handicapped children are children first, and will grow the way children grow, that their emotional needs are the same as those of any other children and that they have a right to experience and to learn in a stimulating manner. The training of the parents is emphasized throughout, and finally the relationship of the child to the home and to the community.

The book is well illustrated by pictures, but more important, it is illustrated by excellent case histories, by very helpful charts, with very readable subject matter which defines the problem, discusses the many approaches which have been made over the years, and finally sums these up into a practical working approach. Each chapter has its own bibliography. I recommend this book most highly. *(Frances Baker, M.D.)*

DIE PHYSIK UND IHRE ANWENDUNG IN MEDIZIN UND BIOLOGIE, BD. III: Kleines Lexiken. By Dr. phil. *Walter Beier;* Dr. med. *Erich Dorner,* and *Otto Lukas.* Cloth. Price, geb. DM 9.85. Pp. 172. Georg Thieme Verlag, Leipzig C 1, Germany, 1960.

This is part of a set of books dealing with physics and its applications in medicine and biology. The three authors are respectively a professor of biophysics, a specialist in internal medicine, and a scientific collaborator. The greater portion of the book consists of definitions, alphabetically arranged, of terms likely to be encountered in the literature of biophysics, including mechanics, acoustics, optics, electronics, and ionizing radiation. The quality of the definitions varies; a few look like hasty memoranda, but most are remarkably explicit, precise, and up to date. Of particular value are the beautifully worked out examples on pp. 155-172. They are graded as to difficulty, beginning with a mechanical problem in inertia and ending with a calculation of rate of radioactive decay; the use of dimensional analysis is well illustrated, and four helpful conversion tables (including two unfamiliar units, the newton and the kilopond) are supplied.

This book might be helpful in translating technical material from German into other languages. It is recommended to the attention of prospective authors and publishers of similar dictionaries, lexicons, and glossaries as proving that extraordinary care in setting forth complete and exact mathematical formulations is quite compatible with the production of a handy, attractive book.

Of the many things man can do or make here below, by far the most momentous, wonderful and worthy are the things called Books.

— THOMAS CARLYLE

The reviews here published have been prepared by competent authorities and do not represent the opinions of the American Congress of Physical Medicine and Rehabilitation and/or the American Academy of Physical Medicine and Rehabilitation.

Labor Program for Rehabilitation

Following are abstracts from a statement which was approved by the Executive Council of the American Federation of Labor and Congress of Industrial Organizations at its meeting on February 15, 1960:

More and more people of all ages are losing or failing to attain status as independent members of society. Causes include population growth, lengthening of the lifespan, new hazards to physical and mental well-being, and failure to make full use of restorative services.

The substantial economic drain of such dependency is measurable in costs of care, in loss of income, and in failure to contribute to production, services, and tax revenues. The social and spiritual costs in undue suffering, in frustration of hopes, in self-recrimination, and in strains on family life cannot be measured but nonetheless are real and of at least equal significance.

Society must make adequate provision for the care of dependent persons. Measures to prevent dependency need to be improved; new ones must be devised. But it is not enough merely to accept and care for the increasing number of dependent persons. Every effort must be made to help them attain their highest degree of self-sufficiency.

The growing recognition of the need for restorative services has brought about, in recent years, substantial increases in governmental and voluntary support of rehabilitation programs. Much more needs to be done – not only in the appropriation of additional funds – but also in the effective mobilization of the diverse forces involved in a comprehensive rehabilitation movement.

Organized labor, as spokesman for the working force and as representative of citizens concerned with individual, community, and national well-being, has a vital role in the development and improvement of rehabilitation services.

The primary role of organized labor in rehabilitation is that of a knowledgeable and dedicated stimulator of, and participant in, organized action in support of better rehabilitation services – in the nation, in the states, and in the local community. The objectives of the labor program for rehabilitation should be designed to meet the present and anticipated major needs.

Needs

Public and professional understanding. There is insufficient awareness of the extent of the problem and of the promise of good rehabilitation services on the part of those who need to be involved in the expansion and support of rehabilitation programs – the public, the legislators, and the governmental and community leaders, including union officials. The potentials of rehabilitation are not fully appreciated by many physicians, hospital administrators, public health officials, and leaders in insurance organizations and health and welfare agencies.

The serious shortage, current and projected, in all categories of health and welfare personnel constitutes one of the chief obstacles to improvement and expansion of rehabilitation services.

Additional resources provided through federal, state, and local governments, voluntary health and welfare agencies, and expanded insurance coverage are essential.

Examples

A few examples of specific activities are cited to indicate the potential and the breadth of the program foreseen. In all these, and in other activities to be

undertaken, a twofold function for labor is anticipated – (1) labor to take initiative on its own, and (2) labor to join with other organizations moving toward the same goals.

- ◇ Work for the establishment of Citizen's Advisory Councils for Rehabilitation in the States which do not now have such councils.
- ◇ Promote, participate in, and publicize state and local surveys related to rehabilitation needs, facilities, and services.
- ◇ Stimulate examination of workmen's compensation laws and second-injury laws with a view to encouraging the greater use of these devices for improved rehabilitation services.
- ◇ Assist in the establishment of medical rehabilitation units within hospitals and allied institutions.
- ◇ Identify the comprehensive needs of individuals undergoing or who have completed rehabilitation services, e.g., for social and recreational services as well as for physical and vocational help, and assist in mobilizing community resources to meet such needs.
- ◇ Become involved in the development of plans for new, and in the operation of existing, sheltered workshops so as to contribute labor's knowledge to the improvement of such facilities.

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Your Attention, *please* . . .

"Letter To The Editor"

Many organizations have been formed by various paramedical personnel. The oldest and best known of these is the American Nurses' Association. This group has worked long to raise and maintain the standards of nursing education and consequently to improve patient care. The American Registry of Medical Technologists is another group that has set high qualifications for membership and has worked to raise the standards of performance by its members. A third group, the American Association of Medical Assistants is designed to take in those women who work in physicians' offices, but who are not registered nurses, registered technicians, or certified medical secretaries, but who may perform some of the duties of all three. This group is closely supervised by the American Medical Association and by county medical societies. Its activities are largely educational and are planned to help the girls do a better job for the physician and the patient. As a result of increasing her efficiency and medical knowledge, she is able to perform her duties more efficiently and, thusly, to increase her earning power.

These three groups need our wholehearted support as they are a credit to the Medical profession.

Several other groups are flourishing and are growing by soliciting members through advertisements sent to the offices of physicians throughout the country and some have been under observation by the Federal Trade Commission and AMA. The most aggressive organization is the American Association of Doctor's Nurses. This group was originally called the American Registry of Doctor's Nurses. Its members were given a pin to wear on their white uniforms and an emblem for their car consisting of a caduceus with the letters RDN. They were also authorized to use the letters RDN after their names. The intent seems to be to make the average observer think that the woman is a registered nurse even though she does not have the training that either a graduate or practical nurse is required to have. No examinations are given by a qualified board. In order to become a member she has to work for a physician for six months and he has to certify that she can do at least eight of 32 different procedures such as taking temperatures, pulses, respirations, weights, blood pressure, giving injections, sterilizing instruments, giving diathermy, bookkeeping, developing x-rays, or any simple laboratory test. The qualifications are so simple that, in my opinion, no formal training is needed. In other words, almost any woman who is willing to pay $12.00 could buy herself a title, a pin, and an automobile emblem that would make her appear to be a qualified member of the nursing profession. The nurses' associations and medical societies in several states have protested this inference with the result that the attorney general of some states has ruled that the organization was illegal. In order to overcome this, following this ruling, the organization changed the name and symbols to leave out the R and now use DN after their names and on the caduceus. But as the Attorney General of Wisconsin said that "the only end that could be sought by a person, not a registered nurse, holding herself out as a "D.N." or "Doctor's Nurse" would be to deceive the public as to her true status in order to share in the prestige and other benefits of professional nursing without assuming the responsibilities and without being subject to the regulations of the licensed profession."

In spite of a ruling by the Federal Trade Commission dated February 19, 1960 that this group cease and desist, they merely changed the name from American Registry of Doctor's Nurses to American Association of Doctor's Nurses and apparently continued much as before. It is important that all physicians be acutely

aware of this situation. Encourage your aide to join the local Association of Medical Assistants, but do not sign a paper that would allow her to imply that you have certified her to represent herself as something that she is not.

— JAMES M. MOSS, M.D.
Alexandria, Va.

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"Progress and Prosperity" . . . . .

portrait of cleveland

This is the story about Cleveland, your convention city for 1961. This is the story about the host city and what it has to offer . . . it is a prospective size-up of the town.

The Cleveland of today is a big, busy city . . . Ohio's first. It is nothing like the spot along Lake Erie and the Cuyahoga River that General Moses Cleveland surveyed in July, 1796. This spot now is a city of more than a million people, the capital of a great trade empire, and an industrial giant ranking with the greatest in the world.

The Cleveland of today also offers all the attractions of a great metropolis befitting its size and prestige. The cultural and educational institutions, the parks, and the entertainment facilities of Cleveland are among the finest in the world. The beautiful shores of Lake Erie, both east and west of the city, offer a great variety of attractions. And the entire area surrounding the great city is one of beauty and interest.

As a place to gather, Cleveland offers many attractions and points of interest. It is perhaps more noted as a cosmopolitan community than any similar metropolis its size because of its heterogenous population. The city, whose metropolitan area stretches out from the Lake Erie shoreline like a fan, is particularly known for its fine cultural institutions and civic spirit and in 1946 celebrated its sesquicentennial.

Cleveland's compact layout is a definite convention advantage. At the hub of the city's business activities in the Public Square, a small clearing of land which was purchased by the Connecticut Land Company in 1795 for $1.76 is now a modern business and transportation center valued at more than $20,000,000.00! Towering over the square is Cleveland's familiar landmark, the 52-story Terminal Tower, with an observation room on the 42nd floor that affords a splendid view of the city.

Cleveland also ranks among the nation's outstanding cultural and educational centers. Western Reserve University, comprising various colleges, is one of Ohio's oldest and best collegiate institutions. Case Institute of Technology, adjoining the campus of Western Reserve, is rated among the country's top engineering schools. The two institutions occupy high ground overlooking beautiful Wade Park. Other Cleveland collegiate institutions are John Carroll University, Fenn, Ursuline and Notre Dame Colleges.

Gems of the city's cultural treasures are the Cleveland Museum of Art and Severance Hall, both located in University Circle overlooking Wade Park on Cleveland's east side. The art institution is one of the most beautiful museum buildings in America and through its cooperation with the city's schools and colleges has become an essential factor in the educational life of Cleveland. Severance Hall is the home of the Cleveland Symphony Orchestra and has done much to carry the story of Cleveland's educational and cultural progress to the rest of the world. Other famous institutions in Cleveland include the Museum of Natural History, the Western Reserve Historical Society Museum, Dunham Tavern, the Public Library, the Health Museum, Brookside Zoo, Nola Park University of Light, and Cleveland Airport.

In addition to visits to Cleveland's many noted landmarks, there is a great variety of recreation and entertainment pleasures in store for the city's guests. Cleveland's show houses present the cream of the nation's theatrical talent. In Playhouse Square, with its 12,000 seating capacity, theatres not only offer excellent productions, but they also are attractions in themselves.

Treat yourself and your family. Plan to explore Cleveland — let Ohio be yours for a while. Make the Cleveland meeting your vocation with play!

we meet . . .

in Cleveland . . .

in 1961 . . .

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